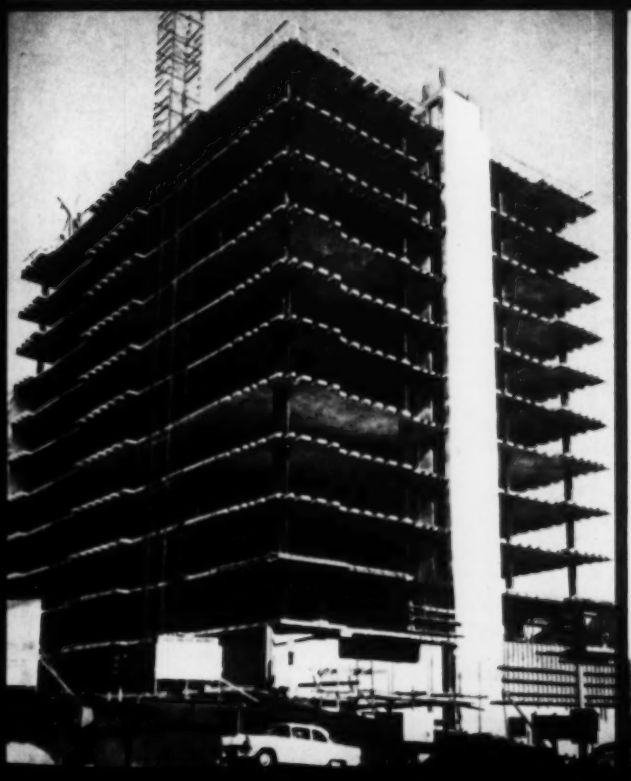
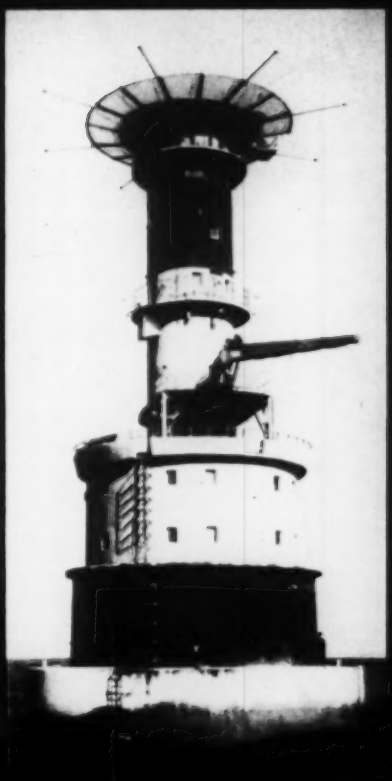
CIVIL ENGINEERING





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	ODD DASH NUMBER SHOWN. NEXT HIGHER	

DIMENSIONS IN INCHES

FRACTION ±	TOLERANCES .X ±	.XX ± .03	.XXX ± .010	ANGLE ±

LAYOUT See file 166-A

CUSTOMERS SEE DWG 33644

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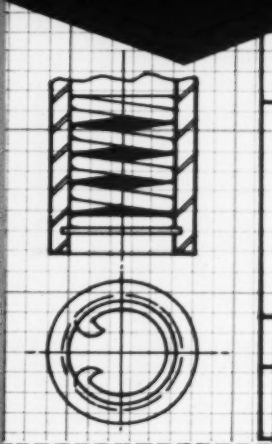

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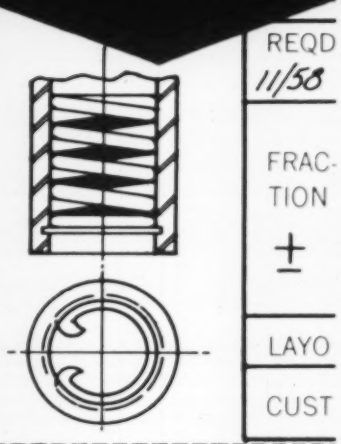

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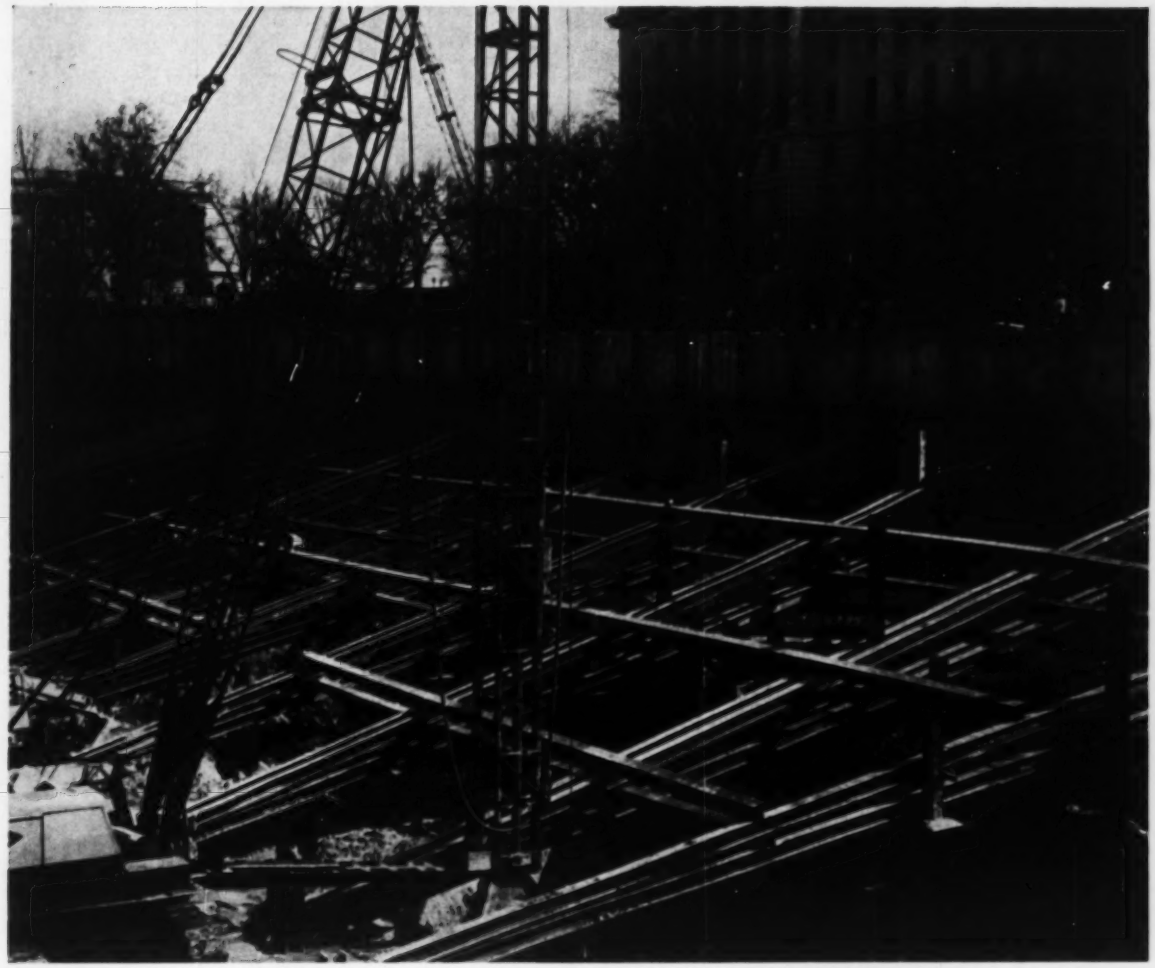

Foundation work at new House of Representatives Office Building, Washington, D. C. **Architect:** J. George Stewart, Architect of the Capitol; **associate architects:** Harbeson, Hough, Livingston & Larson; **structural engineers:** Shelton & Stanford; **general contractor:** McCloskey & Co.

STEEL H-PILES withstand pressures of 1500 psf

Tremendous pressures created by adjacent buildings, heavy traffic, and difficult soil conditions, made excavating hazardous at the new $64 million House of Representatives Building in the nation's capital. McCloskey & Co. of Philadelphia, contractors for the foundation work, licked the problem by using steel to provide a support of ample strength while maintaining adequate working areas.

The shoring system of H-pile soldier beams, wales, and rakers, was designed to withstand estimated lateral pressures as high as 1500 psf in some parts of the site. H-Piles were driven at 5-foot centers to act as soldier beams, and as excavation progressed, 5-foot long oak planks were installed between the flanges. H-beams used as wales and as rakers were used to support this soldier beam retaining wall, which is to be left in place until completion of the project. Bethlehem supplied 2800 tons of H-piles for the soldier beams and structural shapes for the shoring.

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ELIZABETH N J

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Now a new installation technique completely eliminates the need to anchor floor grating in place. This allows erection as fast as the structural steel support members are placed and bolted. The technique is only possible with a special reversible Borden Type K panel which will lie perfectly flat on supporting steel with no tendency to rock.

Furthermore, floor grating can now be installed and used for working and walking as quickly as the main structural members are erected. Two men can lift any panel in a matter of seconds for easy accessibility and maintenance.

BORDEN METAL PRODUCTS CO.

Gentlemen:

Please send new "Engineering Concept" folder.

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TITLE .....

COMPANY NAME .....

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CITY AND STATE .....

THIS IS WORTH KNOWING ABOUT!

For complete information, write for technical folder entitled "An Improved Engineering Concept in the Installation of Floor Grating".

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VOL. 30 • NO. 9

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PROPER *Pre-Shipment* TESTING *Assures* PROFITABLE PERFORMANCE *in the Field....*

IN addition to undergoing exacting tests for mechanical operating efficiency, each GALION Motor Grader, before shipment, receives a thorough engine operation and analysis check on a Clayton Dynamometer.

As a result downtime in the field, due to "new equipment" adjustments and tuning, has been reduced to a negligible point.

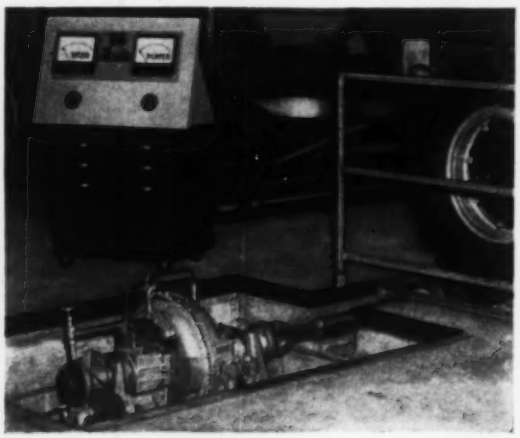
The tests and adjustments are made according to scientific standards. Guesswork, opinions and uncertainties are eliminated. You are assured a grader on which all mechanical parts function properly and the engine delivers top horsepower and speed with utmost fuel economy.

The grader is first tested and adjusted in its highest gear at full throttle for smooth operation with no load. Next the road speed and horsepower are checked under a full load condition. The Dynamometer operator easily controls the load or changes it at will by two remote control buttons.

Speed and torque measurements are electrically integrated, permitting horsepower readings to be shown directly on a large meter without computations being necessary. A matching electric meter shows road speeds in mph regardless of the tire size or rear axle ratio.

For profitable performance — buy GALION! See your Galion Distributor or write direct to The Galion Iron Works & Mfg. Company, Galion, Ohio, U. S. A.

After an initial warm-up period, the grader is moved into place with its tandem drive wheels resting on the Dynamometer testing rolls.



Working conditions are simulated by imposing loads on the Dynamometer rolls thru a closed hydraulic power absorption system.

Interstate road program moves ahead in Utah

USS Highway products help pave the way . . . see inside

Utah's new Interstate road

There are almost 1½ million pounds of structural steel and 3,200 cubic yards of concrete in the Beck's Springs Overpass north of Salt Lake City. Design allows for expansion from four to six lanes. USS Structural Steel used here will withstand great abuse, effectively resist tension, torsion, compression and shear, and can be erected in any weather in which men can work because it's easy to rivet, weld or bolt. This bridge was fabricated and erected by the American Bridge Division of U. S. Steel.

Here USS Steel Sheet Piling is used as a retaining wall along the Salt Lake City Freeway. Nearly 44,000 square feet of steel sheet piling retain the fill next to adjacent property on the east side of the highway.

program moves ahead

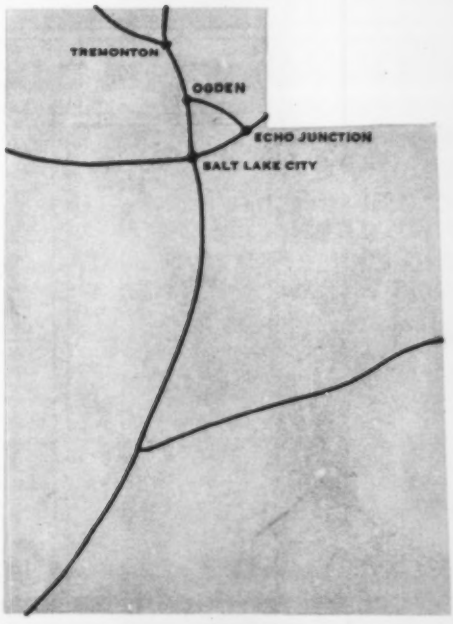
USS Highway Products play a big part

Under the direction of C. Taylor Burton, Chairman of the State Road Commission, and Director of Highways Elmo R. Morgan, 965 miles of Interstate roads have been authorized in Utah. 40 miles have already been completed, 82 additional miles are now under construction. In addition, 66 of 600 planned bridges have been completed.

Highway products from U. S. Steel are playing a big part in Utah's new Interstate Road system. In the bridges, for instance, the strong USS Structural Steel being used is one of the most economical of load carrying materials. It is available for the construction of bridges of all types in a number of USS High Strength Steels as well as structural carbon steel. Other USS products include reinforcing bars in the bridges, AMERICAN Welded Wire Fabric in the roads, and high strength steels and wire rope in cranes and other machinery. For safety, U. S. Steel supplies signs, posts, guard rail and galvanized sheets for culverts.

Approximately 1,600,000 cubic yards of blast furnace slag from Columbia-Geneva Steel Division of U. S. Steel will be used as embankment material on a new project recently awarded by Utah State Road Commission. Known as Interstate Highway Route 15, the project spans a 4.94-mile section where blast furnace slag will provide a stabilized embankment for the pavement and shoulder area.

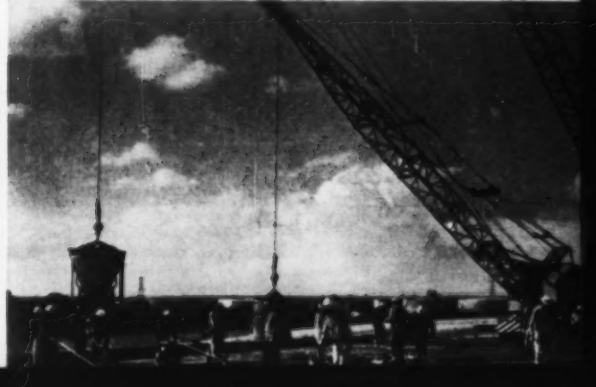
USS, Di-Lok, Tiger Brand, and American are registered trademarks



Map shows Utah's new Interstate highway network.

808 lineal feet of strong, long-lasting steel handrail gleam in the mountain sun on this bridge on the Davis Freeway near Bountiful, Utah. Steel products like these contribute to the safety of traffic on modern Interstate Roads.

USS Tiger Brand Wire Rope, seen here on these gigantic cranes, will lift heavy loads for a long time. The bridge is also being built to last, with the use of USS *Di-Lok* concrete reinforcing bars. STEEL, wherever you look—insures strong, long-lasting structures.

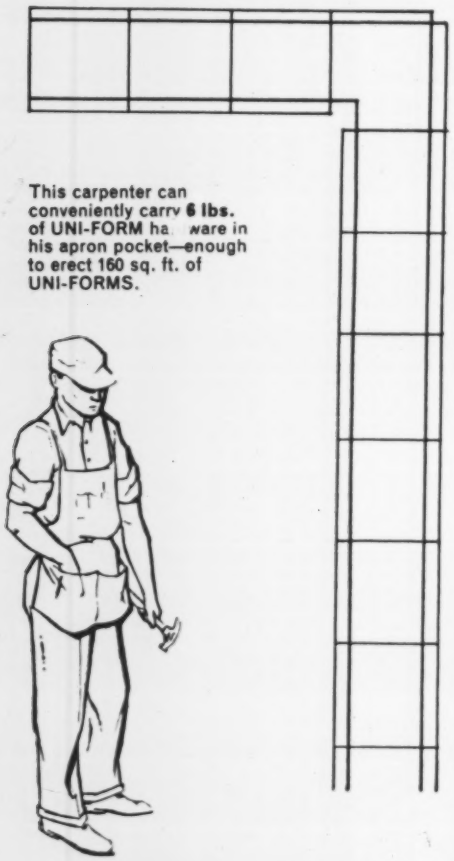


Send for U.S. Steel's **free** *54-page booklet, "Keep Our Roads on the Go." It tells how the complete range of highway products and services available from U.S. Steel can cut costs and speed operations in every phase of highway construction. United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.*

USS United States Steel

The highway market also is served by the following divisions of United States Steel: American Bridge Division, Pittsburgh, Pa. • American Steel & Wire Division, Cleveland, Ohio • Columbia-Geneva Steel Division, San Francisco, Calif. • Consolidated Western Steel Division, Los Angeles, Calif. • National Tube Division, Pittsburgh, Pa. • Tennessee Coal & Iron Division, Fairfield, Alabama • Universal Atlas Cement Division, New York • United States Steel Supply Division, Steel Service Centers, Chicago, Illinois.

WHICH PREFAB FORM SYSTEM OFFERS MORE PRODUCTIVE FORMING TIME PER DAY?



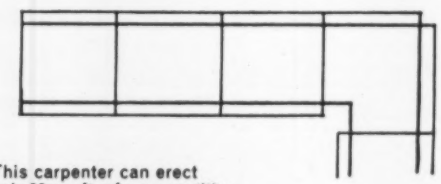
This carpenter can conveniently carry **6 lbs.** of UNI-FORM hardware in his apron pocket—enough to erect 160 sq. ft. of UNI-FORMS.

UNI-FORM SYSTEM

Carpenters can form more contact area per hour with UNI-FORM Panels than they can with any other prefab form system. The reason? It takes less hardware — in most cases, 50% less — to form a given contact area. And UNI-FORM hardware **weighs less, costs less,** and is easier to install.

EXAMPLE: **6 lbs. of UNI-FORM hardware — 128 Tie Keys — are required to install 32 UNI-FORM Ties (4 keys per tie).** 32 Ties are required to erect 160 sq. ft. of UNI-FORM Panels.

Cost of hardware required to install 1 UNI-FORM Tie: **LESS THAN 4¢.**
(Tie Keys are re-usable)



This carpenter can erect only 60 sq. ft. of a competitive prefab system's panels with the **6 lbs.** of hardware he carries in his apron. **Extra trips for hardware means less productive forming time.**

COMPETITIVE PREFAB FORM

A leading competitive prefab form system requires 2 tightening wedges and 2 connecting bolts per tie installed. **In 6 lbs. of this hardware, there are only 24 sets of wedges and bolts — enough for 12 ties.** 12 ties will assemble **only 60 sq. ft.** of this system's panels.

Cost of hardware required to install 1 competitive tie: **36¢.**
(Wedges and Bolts are re-usable)

WHICH PREFAB FORM SYSTEM GIVES YOU FASTER FORM ERECTION AND LOWER COSTS? Want more information about UNI-FORM Panels and the advantages they can bring to your concrete forming? Write today for complete details.

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Some Ideas

for your file of practical information on surveying... from **KEUFFEL & ESSER CO.**

"For want of a nail . . . the battle was lost." This might well be the epitaph for many a tardy survey. The right surveying accessories can do wonders to speed a field party's operation . . . and the lack of same can cause delays in a hundred minor ways a day. How goes the tempo of your work lately? . . .

Does your flagging really flag?

This K&E flagging does everything but tie its own knot. Made of tough, embossed vinyl plastic, it's practically impervious to time and tempest. Unlike the "quick-to-quit" red cloth commonly pressed into flagging service, this plastic flagging resists wind ravel like the stake itself, remains supple even at – 35° F., tears quick and clean, has exceptionally high tensile strength, and takes both pencil and ball-point pen like paper. Available in five high-visibility colors (red, yellow, blue, orange and white), K&E Plastic Flagging (No. 6525) measures 1¼" in width and comes in handy 4" diameter, 300' rolls. Great for gift wrapping and decorating, too!

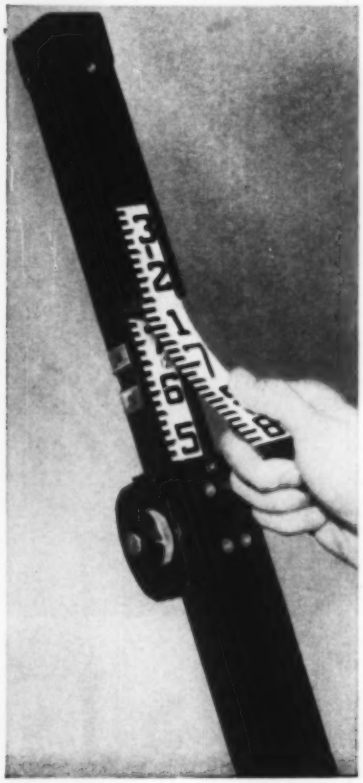
You're only as good as your scales

A complete line of hard-to-get items has long been a K&E specialty. Of particular interest here is K&E's comprehensive line of Leveling Rod Replacement Scales. Available for all K&E metal-face rods, these replacement scales are marked in the conventional pattern and design in feet, 10ths and 100ths. In addition, they feature "ready-reading" foot numbers in red between the 3rd, 4th, 6th and 7th tenths to facilitate reading on short shots when the main foot marks are likely to be outside the field of view.

If your off-the-rod readings seem to be a bit fuzzy lately, don't throw out an expensive rod, simply replace the face with an inexpensive *new scale*. It takes but a few minutes with a screwdriver and small hammer to install one of these nominally-priced replacements. And how about carrying a spare for emergencies?

Should a leveling rod be level?

The unassisted naked eye – despite its widespread popularity – is *not* the tool to guarantee a vertical leveling rod. A handy K&E device called a Rod Level (No. N6299) is the proper Rx here. It's a simple bubble unit on a long-angle contact arm that affixes to the edge of the leveling rod in semi-permanent fashion. When the bubble is centered, the rod is vertical . . . and no mistake about it! This inexpensive but accurate device eliminates guesswork, makes for truly *precise* readings, and works easily – no juggling act required, just a fairly steady hand.



Now, for carrying this equipment...

... may we suggest the handsome Surveyor's Leather Bag (No. 6540)? Here's a sturdy carry-all expressly made to withstand the rigors of field work. Heavy-duty stitched throughout, it has an adjustable shoulder strap with movable pressure-pad, rust-resistant brass hardware, separate pad and paper slot, roomy interior pocket, and a rich riding-boot finish in natural tan. Measuring 10" high by 12" across by 2½" wide, it affords plenty of room for field book, plumb bob, tacks, targets, pencils, keel, measuring tape, numerous rolls of plastic flagging, replacement scales, and a rod level . . . to say nothing of your lunch, a few trout flies, etc.

All these and other K&E time-savers are available from your local K&E Dealer . . . or you can send us the coupon below for further information.

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☐ Rod Level
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1932

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PERMANENTLY YOURS: CAST IRON PIPE

Installed... it stays installed

One thing sure about cast iron pipe—once it's in the ground, it's there for keeps! Over 100 American utilities, having used cast iron pipe steadily for more than a century, can testify to that. And *modern* cast iron pipe gives you greater assurance than ever: great beam strength resists heavy surface traffic; tremendous load resistance absorbs even the most forceful pressures. In fact, when you select cast iron pipe, you can anticipate no major repairs in your water supply system for the next hundred years!

Cement-lined—it stays cement-lined

A smooth coat of cement lining along the inner wall helps prevent the formation of flow-reducing particles. No matter how strong the water is, cast iron pipe always assures a free, steady flow.

Joined—it stays joined

Bottle-tight, rubber-ring joints give you leak-proof protection at the most vulnerable points of your system. Vibrations, surface traffic and washouts present no problem to cast iron pipe. Inherent ruggedness . . . built to perform under all adverse underground conditions . . . repair-free service for at least a century—all good reasons why your choice should be that of water utility experts everywhere. America's greatest water carrier: cast iron pipe.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois

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2-1" lifts Type I-2AC Wearing Surface

2-3" lifts "Black Base"

7" to 12" compacted mechanically stabilized base

CROSS SECTION VIEW OF PAVEMENT CONSTRUCTION

On Interstate Route 95, North Carolina, the Nello L. Teer Company, of Durham, North Carolina, is the prime contractor on a highway construction project that includes the largest asphalt tonnage contract ever awarded by the North Carolina Highway Dept.

This project fittingly crowns 50 years of activity in the construction field by the Teer Company.

The job called for new construction of divided pavement each side 24' wide, south from the Harnett County line 14.55 m. to a point 5 m. north of Fayetteville.

The paving contract covered the placement and compaction of 7" to 12" of mechanically stabilized base; placement and compaction of Asphaltic Concrete "Black Base" course in two 3" lifts; and placement and compaction of Type I-2 Asphaltic Concrete wearing surface in two 1" lifts. Asphalt surface treated shoulders were provided full length over a mechanically stabilized base.

Overall, the "Black Base" and I-2 Wearing Surface required 210,000 tons of Asphaltic Concrete.

All work is being done under Project 8.13438. Sponsor: North Carolina State Highway and Public Works Commission. Resident Engineer: H. B. Smith; Division Engineer: J. W. Spruill, 6th Division, Fayetteville, N. C.

Chevron Asphalts: supplied by American Bitumuls & Asphalt Company, represented on the job by Sales Engineer George Mitchell.

Across the nation, Chevron Asphalts—backed by outstanding engineering and on-job service—are enabling Road Builders to maintain construction schedules and stretch highway dollars.

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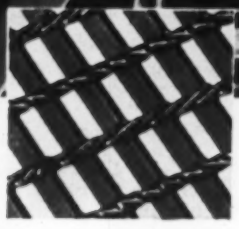

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When you specify Kerrigan Weldforged grating you get the utmost in underfoot and underwheel safety . . . in addition to its well known economy features. Bearing bars, and cross bars that alternate right and left, are electronically weld-forged into inseparable, one-piece units that stand up under the severest kind of punishment.

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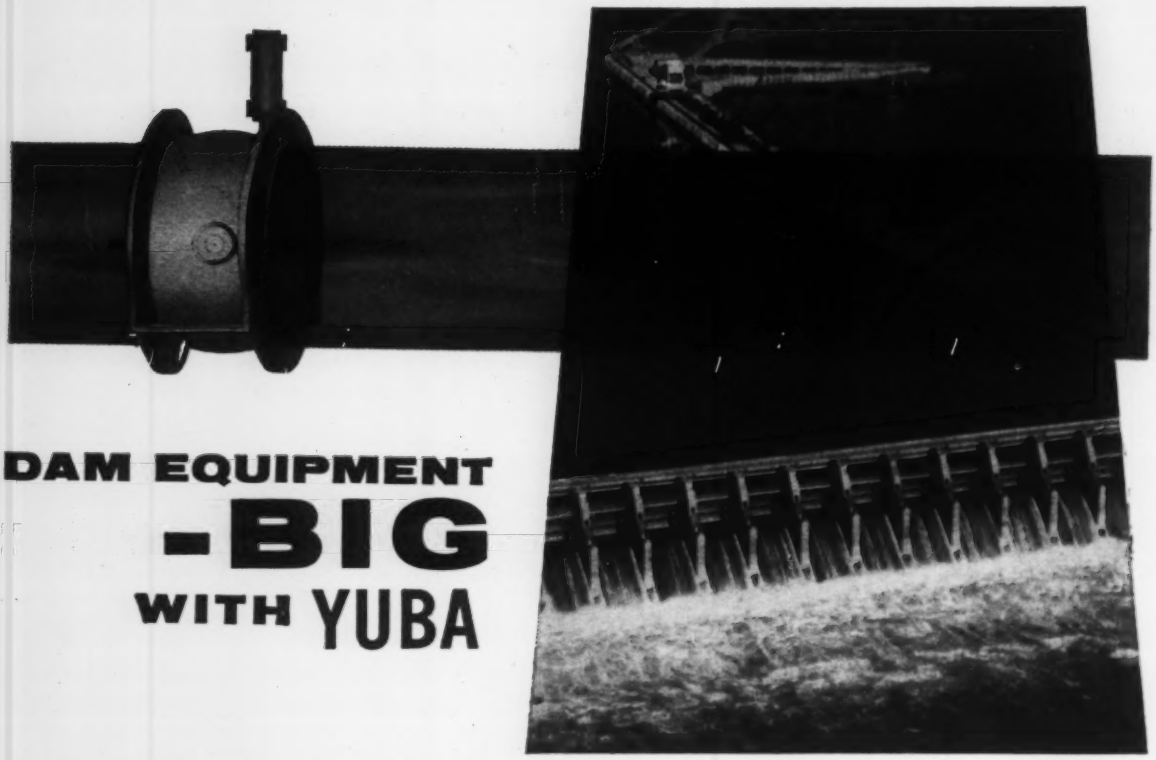

DAM EQUIPMENT -BIG WITH YUBA

From forebay to tailrace—Yuba takes the complete responsibilty—through design, fabrication and erection of steel equipment in hydro, flood control and water supply projects.

Call on Yuba for bridge and gantry cranes, hoists, intake, spillway and draft tube gates, bulkheads, trashracks and rakes, penstocks and liners, valves, structural steel, rebar, and other engineered steelwork.

Whether it's a single giant butterfly valve or the complete job responsibility, Yuba is equipped to work with contractors from design to erection of the fabricated steelwork required – everything from forebay to tailrace. When Yuba handles the complete package responsibility, both the contractor and the user are relieved of the problems of coordinating production, delivery and installation. Decades of experience, know-how of skilled personnel, and large, fully-equipped production facilities, are your assurances that specifications and schedules will be met, however complex the job, whatever the job location. Ask for Bulletin No. HY-51, describing equipment and services, or ask for a sales engineer to call.

YUBA

specialists in hydroelectric steelwork

YUBA MANUFACTURING DIVISION • *Benicia, Calif.*
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YUBA CONSOLIDATED INDUSTRIES, INC.

Sales Offices in Atlanta • Buffalo • Chicago • Cleveland • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Seattle

LATEST WORD FROM MARS is the superb new Technico lead holder—with clear-view degree indicator placed right at your fingertips. Contoured for perfect balance, with new positive finger grip, it's the newest of many fine MARS drafting aids—all designed to make your work easier, and to make it look better and reproduce better.

Among the famous imported Mars drafting products are: the Mars-Technico push-button lead holders (with adjustable degree indicator*, with specific degree imprint, the economy model*); Mars-Lumograph drawing leads*, 18 degrees, EXB to 9H; Mars-Lumograph drawing pencils, 19 degrees, EXEXB to 9H; Mars-Duralar pencils and leads for drafting on Mylar®-base drafting film—5 special degrees, K1 to K5; Mars-Duralar Technicos with adjustable Duralar degree indicator; Mars-Lumochrom colored drawing pencils, 24 shades. Also: Mars Pocket-Technico for field use; Mars pencil and lead sharpeners; Mars Non-Print pencils and leads; Mars-Duralar erasers. Mars products are available at better engineering and drafting material suppliers everywhere.

® T.M. for duPONT's Polyester film. *Shown.

the pencil that's as good as it looks **MARS**

J.S. STAEDTLER, INC.
HACKENSACK, NEW JERSEY

One ingenious, pleasant and immensely practical way to get people to enjoy an island park is to *carry* them there through the air. Starved Rock Airpark Inc. did just this by erecting a passenger tramway that "flies" over the Illinois River. The owner reports the facility has met with considerable success—both from an aesthetic aspect as well as that of moving people from one point to another.

When it comes to moving anything from one point to another via a suspension system, it's time to say, "Roebling." Our experience with tramways of every description is unparalleled from design to erection. You may not have a state park that you'd like more people to enjoy—you may, though, have a passenger—or materials-handling situation that you'd like to get off the ground. In which case you have only to write to Roebling's Bridge Division, Trenton 2, New Jersey for the "moving" details.

ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation

Visitors "Fed" to Illinois' Starved Rock Airpark

Via ROEBLING-DESIGNED PASSENGER TRAMWAY

Starved Rock Airpark Passenger Tramway, Starved Rock State Park, Illinois. Consulting Engineer: *Edward P. Haugen, LaSalle, Ill.* Cables & Tramway: *John A. Roebling's Sons Division, Trenton, New Jersey*

MORE NEW TRAXCAVATORS

THE 2¾ yd. 966

THE 1¼ yd. 922

NOW THREE WHEEL LOADERS...BIG IN EXPERIENCE

Now there's a Caterpillar wheel loader for your job—the new *2¾ yd., 140 HP 966* for high production where you measure time in tons loaded—the *2 yd., 105 HP 944* introduced this spring and already gaining an acceptance unmatched in machine history—the new *1¼ yd., 80 HP 922* with the big machine operating and safety features that give it the speed and versatility to handle all those jump-and-run jobs.

There's a seven-year history of testing, torturing and working these Traxcavators . . . proving every component, every feature. They've been on tough jobs all over the country with field engineers watching every cycle, recording every strain.

Now Caterpillar's full line of wheel loaders is proved and ready for work—ready without compromise. They'll fulfill all your expectations of the most advanced wheel loaders on the market today.

See the one man with all the facts on the new Traxcavators—your Caterpillar Dealer. He can give you the full story on the wheel loaders that are brand new in features.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

The 966 and 922 have all these features introduced by the 944:

Cat Diesel Engines – Turbocharged for efficiency and quick acceleration.
Optional gasoline engines for the 922 and 944.

Cat Power Shift Transmission – gives instant shifting, forward and reverse, 1st and 2nd speeds. High and low range selector also provides two-wheel drive for roading, four-wheel drive for power and traction in work cycles.

Operator Safety – Lift arms and cylinders are forward of the operator and cockpit. Visibility is excellent and access is easy . . . up three wide steps.

Long Reach – With the lift arms up front, the dumping reach of the new Traxcavators is impressive: 57" on the 966, 51" on the 944 and 41" on the 922.

Operator Conveniences – Bucket controls have automatic positioners to speed every cycle; machine controls are all power boosted for easy operation. Dual brakes give operator choice of braking with or without transmission engagement.

Full Line of Attachments – Special material buckets, side dump buckets, forks, cabs, etc.

CATERPILLAR

Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

TRAXCAVATORS ARE MAKING OTHER LOADERS OBSOLETE

STEPHENS-ADAMSON

CURVE CROWN®

PULLEYS

FEATURING "SQUEEZELOCK" HUB DESIGN

FOR GREATER BELT TRAINING EFFECT . . . REDUCED BELT WEAR

STURDY RIM CONSTRUCTION

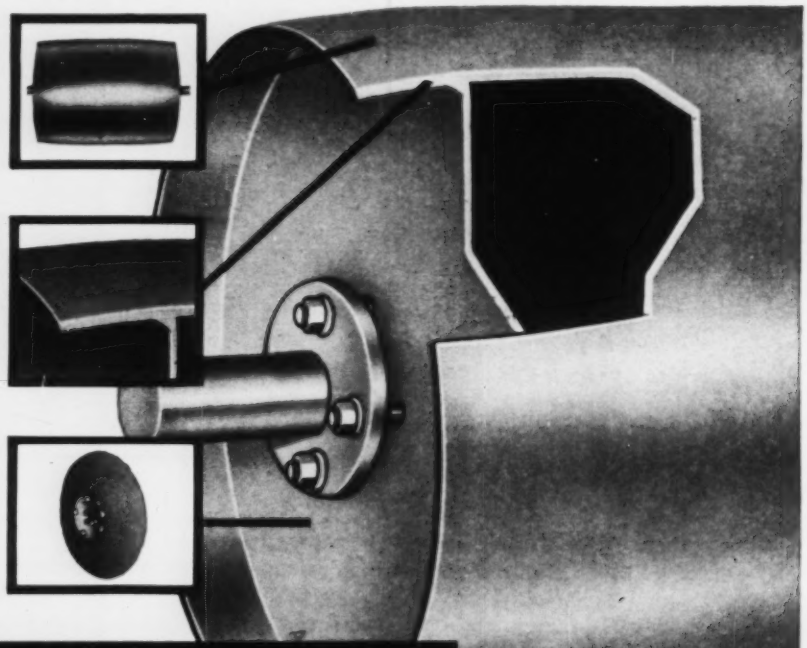
Pulley rims are made of one-piece construction, formed absolutely round under hydrostatic pressure. The only seam is machine-welded both inside and out to insure 100% penetration of welds.

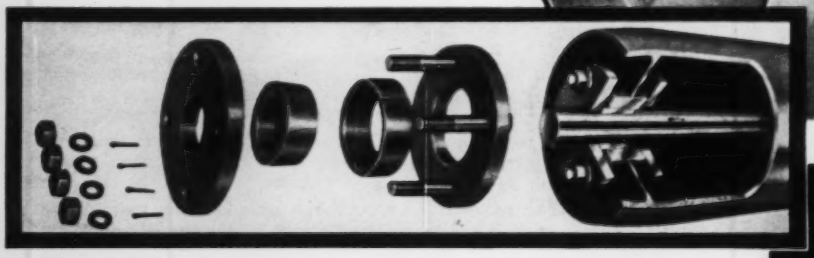
CURVE CROWN® DESIGN

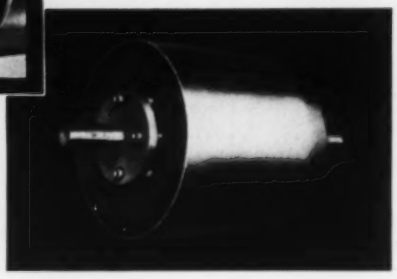
Curve Crown on outer ends of rim accurately formed. Revolutionary design eliminates conventional center peak — high point for belt stretch and wear —while increasing belt training effect more than 100%.

ACCURATE END PLATE ASSEMBLY

End plates are machined on both the O.D. and I.D. to insure concentricity between the bore and the outer rim. They are pressed into position for tight fit-up and submerged arc-welded for maximum efficiency.







"SQUEEZELOCK"® HUB Revolutionary design of "SQUEEZELOCK" Hub provides gripping power for full torque transmission without the use of keyways and eliminates distorting loads against pulley end plates. Two split tapered bushings are wedged against shaft and pulley end plates by two independent hub plates which are squeezed together by tightening four large diameter bolts.

Write for Bulletin 558

S-A

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MATERIALS HANDLING PRODUCTS
SPEEDWALK PASSENGER CONVEYORS
FAIRMATIC BALL BEARING UNITS
SPHERCO BEARINGS & ROD ENDS

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BELLEVILLE, ONTARIO

The Motor City's New Convention Facility Stands On RAYMOND Foundations

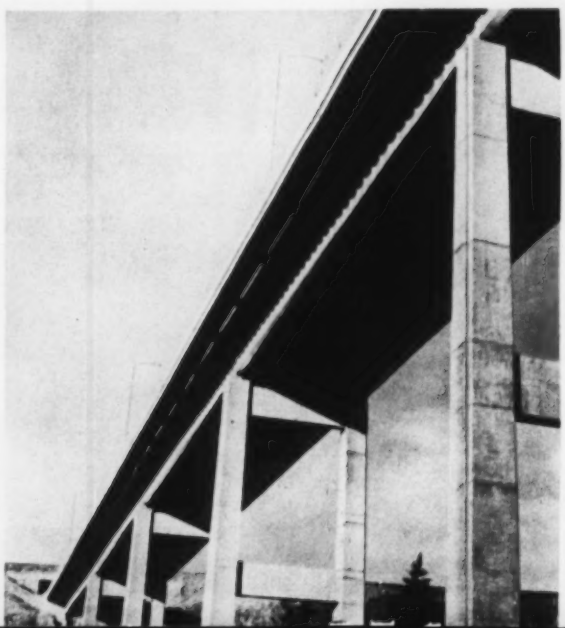
General Foundation Contractor: Darin & Armstrong, Inc. Architects and Engineers: Giffels & Rossetti

Rising proudly on a foundation by Raymond, Detroit's new Cobo Hall completes the vast complex that is the city's Civic Center. With the new City-County Building and the Ford Auditorium (both also on Raymond foundations), Cobo Hall furnishes the ample convention facilities that have been so sorely needed in this booming city. Including 1,632,690 square feet of usable space and room for 12,500 people at meetings and other functions, Cobo Hall will first play host this October to the National Automobile Show. *The Foundation:* 4,341 one hundred and eight foot pipe step-taper piles, for a total of 468,828 linear feet. Detroit's Cobo Hall is another new star in the galaxy of great public buildings large and small, supported by Raymond Foundations. So whatever your needs in foundation construction, give us a call. We can handle almost any problem with men, material, and experience — quickly and economically.

RAYMOND INTERNATIONAL INC.

Foundations and specialized construction in America . . . complete construction services abroad.

New Maple Street Bridge, Spokane, Washington, designed in steel for economy and fast erection.



Underside of Maple Street Bridge showing built-up steel members. Steel can be readily welded, flame-cut, riveted or bolted.

This mark tells you a product is made of modern, dependable Steel.

Steel

Admiral Carl A. Trexel, Vice-President, Leslie A. Helgesson, Vice-President, and Ralph A. Tudor, President, discussing plans for a steel bridge.

Steel specified in 80% of bridge work

at Tudor Engineering Company, Consulting Engineers, San Francisco

Some of the recent outstanding bridges this firm has designed include the Dalles and Umatilla Bridges across the Columbia River in Oregon; the Maple Street Toll Bridge over the Spokane River at Spokane, Washington; and another toll bridge which spans the Port Washington Narrows at Bremerton, Washington.

Of these, the Maple Street Bridge is the most outstanding example of the use of structural steel in short-span bridge design to gain the advantages of economy and rapid construction. The bridge is 1,713 feet long and is built of steel with four 150-foot spans, two 125-foot sections and five 100-foot sections. It supports four roadways.

Steel reduces costs. According to Mr. Ralph A. Tudor, President of Tudor Engineering Company, steel construction offered a great advantage for this bridge because a crew could swing a section into place, bolt it to the supports, and then move ahead to the next section. No falsework was involved, the erection was fast, clean and safe, and the design was the most economical solution.

Steel saves design time. Steel is a familiar material and there are no unknown factors. This is important because the designer is looking for reliable performance. The new electronic calculators can be used to work out mathematical problems quickly in steel bridge design.

Steel permits increased headroom. New highway regulations are calling for increased headroom and this can be obtained most economically with steel. Bridges can be designed with higher strength steel, such as USS MAN-TEN, TRI-TEN or "T-1" brands, that add valuable inches of clearance with less weight and reduced foundation costs.

Steel production facilities increased. The steel industry has greatly expanded its facilities for manufacture of structural shapes and plates. You can confidently design in steel—the material you know best, and the material that offers most —knowing it will be available.

USS, MAN-TEN, TRI-TEN and "T-1" are registered trademarks

USS Steels for Bridge Design

Structural Carbon Steel 33,000 psi minimum yield point	**USS MAN-TEN High Strength Steel** 50,000 psi minimum yield point
USS TRI-TEN High Strength Steel 50,000 psi minimum yield point	**USS "T-1" Constructional Alloy Steel** 100,000 psi minimum yield strength

USS

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

United States Steel

NEWS OF MEMBERS

Robert H. Randall, who retired recently as assistant on cartography with the U. S. Bureau of the Budget, is now vice president of the Aero Service Corporation, Philadelphia, Pa. During 20 years in government work Mr. Randall held many important posts. He was president of the Pan American Institute of Geography and History; U. S. member and chairman of the United Nations Committee on Cartography; and chairman of the U. S. delegation to the Pan American Institute of Geography and History meetings for eight terms from 1943 to 1958.

William S. Housel, professor of civil engineering at the University of Michigan, has been in Chile this summer delivering a series of lectures at the University of Chile.

Herbert D. Vogel, Brigadier General, Corps of Engineers (retired), recently received the Order of the Crown of Thailand, with Star and Sash—the highest honor conferred by the country on persons other than nobility and chiefs of state. The presentations to General Vogel, who is chairman of the board of directors of the Tennessee Valley Authority, took place during the visit of the King and Queen of Thailand to the Tennessee Valley in the course of their official visit to the United States.

C. Douglas Riddle and **Thomas F. Taylor** have opened a consulting engineering office under the name of Riddle and Taylor, at 1182 West Peachtree Street, N.W., Atlanta, Ga. Both Mr. Riddle and Mr. Taylor have extensive background experience in dams, powerhouses, tunnels, and heavy industrial construction. Mr. Riddle was formerly vice president of engineering, and Mr. Taylor, chief engineer of the Walsh Construction Company of New York City.

C. D. Riddle

T. F. Taylor

Edward E. White has been elected president of the New York firm of Spencer, White & Prentis, foundation engineering experts. He has been with the firm since 1933. Past-President **Joseph C. Weaver** has been elevated to chairman of the Board and **Robert E. White,** since 1934 a member of the firm, has been named executive vice president. In the years of Mr. Weaver's presidency, Spencer, White & Prentis expanded its operations into Canada and opened new offices in Chicago, Washington, D. C., and Detroit.

John H. McMillan, after four years as an instructor in civil engineering at Clarkson College of Technology, has been promoted to assistant professor. Professor McMillan is currently attending the Summer Institute for College Teachers of Structures and Soil Mechanics at Oklahoma State University under a National Science Foundation grant.

G. Glen Gage, internationally known specialist in heavy construction, an-

(Continued on page 24)

STEVENS
TOTAL FLOW METER
Model 60M

Low-cost meter provides essential flow data for operation of sewage treatment plants

- **INDICATES FLOW**—Rate of flow and head are indicated by pointer and scale.
- **INDICATES PEAK FLOW**—Sliding red index on scale indicates peak flow.
- **TOTALIZES VOLUME**—Counter totalizer registers total flow.

Mechanically operated meter provides essential data in measurement of sewage, industrial wastes, irrigation water or other liquids flowing in open channels. Standard meter gives direct flow reading in cu. ft./sec. and totalizes volume in cu. ft. Readings are easily converted to other units of measurement.

The instrument is designed for use with Parshall flumes and various weirs. It is entirely mechanically operated, will function without attention for eight-day intervals, and is easy to install on table, shelf or wall. If a graphic record is desired, the meter can be used with a Stevens Type F Recorder. Write for Stevens Hydrologic Instrument Short Form Catalog No. 23, and for Bulletin 28 which describes the Model 60M meter in detail.

HYDROGRAPHIC DATA BOOK—Valuable reference file, 124 pages of technical data on recorder installations, plus a wealth of hydraulic tables and conversion tables. $1 copy. (No C.O.D.'s)

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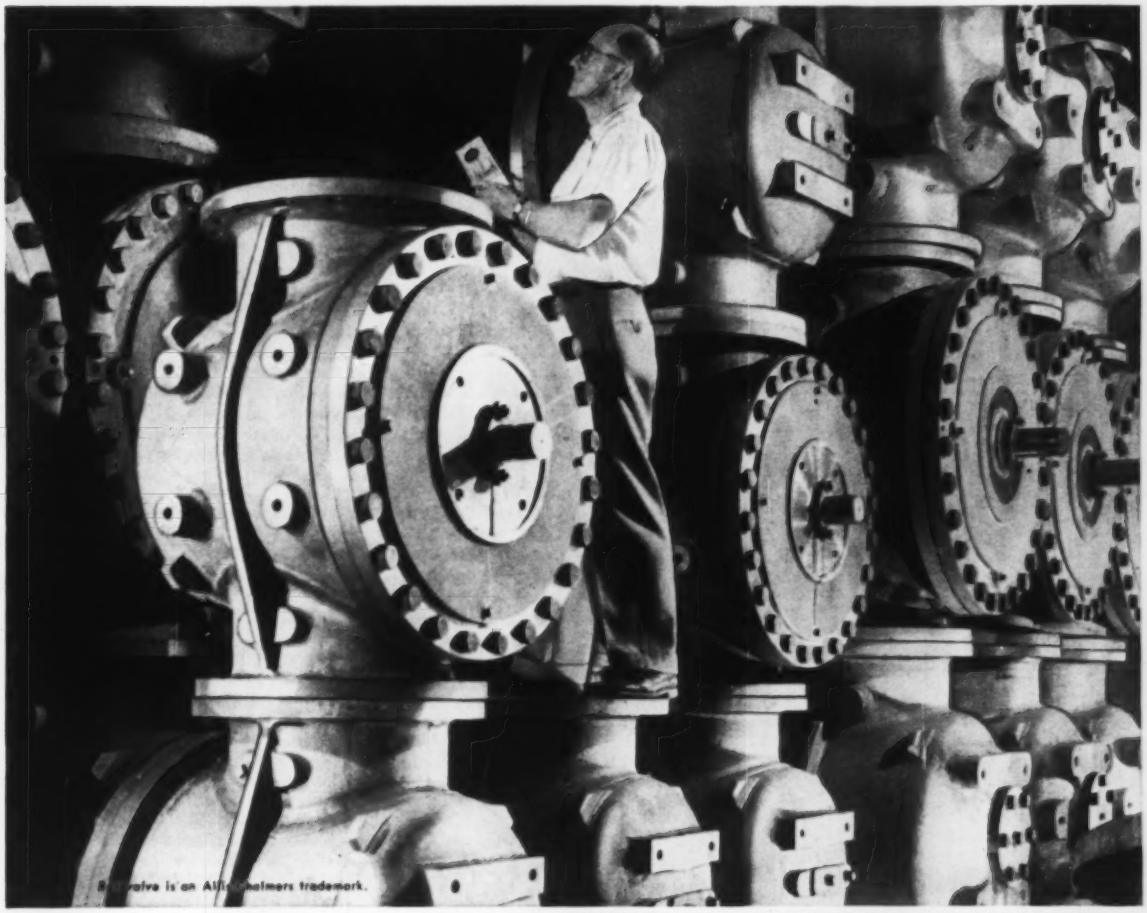
Specialists in hydrologic instruments for over half a century

ALLIS-CHALMERS

A-1260



ROTOVALVE stocks at A-C York Works save months of delay for customers.

Another Allis-Chalmers time-saving exclusive:

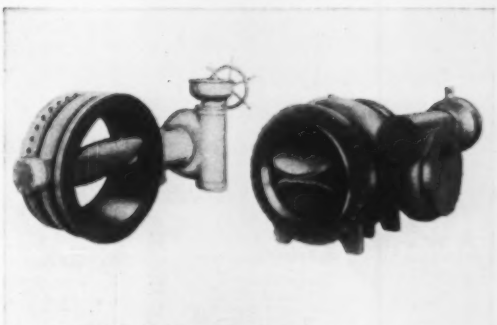
Cone valves "right off the shelf!"

Six to thirty-inch *Rotovalve* units — awaiting your call. Think of the valuable time you save! Typical is the case of a western municipality that recently needed one 24-inch and three 20-inch *Rotovalve* units for their waterworks. Allis-Chalmers assembled all accessories required, completed testing and shipped the valves to customer in less than three weeks! Compare this with the 3 to 6 months normally required by other suppliers for delivery.

Perpetual off-the-shelf inventory of *Rotovalve* units, butterfly and ball valves gives Allis-Chalmers today's only complete rotary valve-stocking program . . . guarantees fastest deliveries to you.

Avoid troublesome, costly delays and get the valves you need to do the job right. For immediate assistance anytime, call your nearby A-C valve representative, district office or write **Allis-Chalmers,** Hydraulic Division, York, Pa.

Rotovalve is an Allis-Chalmers trademark.

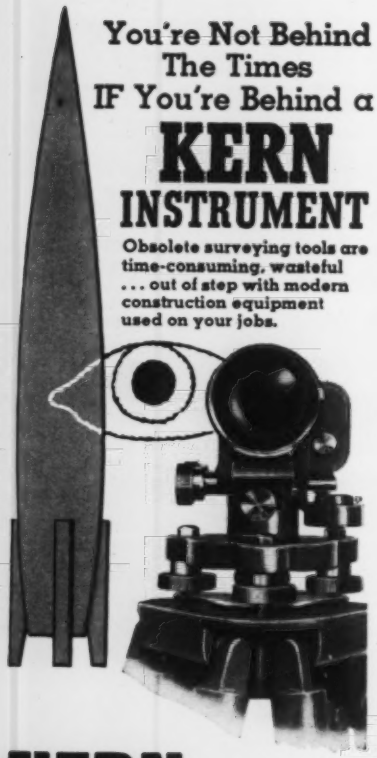


Standard butterfly and ball valves illustrated are also available from stock in a broad range of sizes.

You're Not Behind The Times IF You're Behind a

KERN INSTRUMENT

Obsolete surveying tools are time-consuming, wasteful ... out of step with modern construction equipment used on your jobs.



KERN THE MOST MODERN surveying instruments available. Down-to-fundamentals, functional design ... maximum operational efficiency and portability ... reliable precision results.

KNOWN THE WORLD OVER

for accuracy, speed, reliability, economy.

- Minimum set-up time
- Fast, effortless, simple operation
- Readings at a glance
- Exceptional clarity and contrast of image

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120 Grand St., White Plains, N.Y

nounces the formation of Construction Consultants Inc., with offices in Sacramento, Calif. Mr. Gage has been consultant to the Venezuelan Government on all their reclamation projects, was in charge of the Serre Poncon Dam in France, and has made economic and feasibility studies of civil works in Greece, France, Spain, Africa, Peru, Venezuela and Mexico, as well as the United States.

C. Franklin Steiner is the new district sales engineer for the Pacific Northwest for Process Engineers, Inc., a division of the Eimco Corporation. Prior to joining Process Engineers in 1958, Mr. Steiner served as a sanitary engineer with the California Department of Public Health.

John F. Mangan, a staff member of the Bureau of Reclamation since 1937, is now officially area engineer for the Upper Columbia River Development Area. In his new position, Mr. Mangan who recently has been acting area engineer, will be in charge of all Bureau of Reclamation studies and investigations of proposed and future irrigation projects in Washington, northern Idaho, and western Montana.

John H. Dudley, assistant commandant of the Army Engineer School at Fort Belvoir since 1958, retired in July, after a 30-year military career. General Dudley, who has an impressive list of academic achievements, plans to teach in the engineering department of Long Beach State College. During World War II he served in the Pacific Theater of Operation in various command and engineering positions.

William M. Jaekle, after five years as chief engineer of the Southern Pacific Company's Pacific Lines, has been promoted to general manager of the company, with headquarters in San Francisco. Mr. Jaekle joined the Southern Pacific in 1934, working his way up from rodman to chief engineer.

Bruce D. McCreary, formerly of the firm of Porter, Urquhart, McCreary & O'Brien, San Francisco, which was dissolved due to the death of Col. Leonard C. Urquhart in March 1960, is co-founder of the newly created firm of McCreary-Koretsky Engineers. Offices will be maintained at 1140 Howard Street, San Francisco, and at 5675 Freeport Boulevard, Sacramento. In addition to the water development and hydroelectric projects taken over from the former firm, McCreary-Koretsky Engineers is the consulting engineer for Sunset City, a projected metropolis to be located north of Roseville, Calif.

Hamilton V. Bowser has been promoted from chief structural engineer to project engineer of Engineers Inc., of Newark, N. J. Before joining Engineers Inc., he was structural designer with L. Berger Associates and the consulting firm of Porter, Urquhart.

Gerald E. Galloway, for the past two years Commanding General of the Army Engineer Center and Fort Belvoir (Va.), has been assigned as division engineer, Pacific Ocean, Honolulu, Hawaii. During World War II he was director of training, Engineer Amphibian Command, at a time when the Command was a new concept.

Grayson Gill, president of Grayson Gill, Inc., architects of Dallas, Tex., has been appointed by the National Research Council, parent organization of the Building Research Institute, to serve a three-year term on the Institute's Board of Governors. **Howard E. Phillips,** building engineer with the American Telephone & Telegraph Company in New York, will be a vice-chairman of the Programs Committee, while **William F. Reardon,** design standards engineer with the General Electric Company, Schenectady, N. Y., will continue as vice-chairman of the Plastics Study Group.

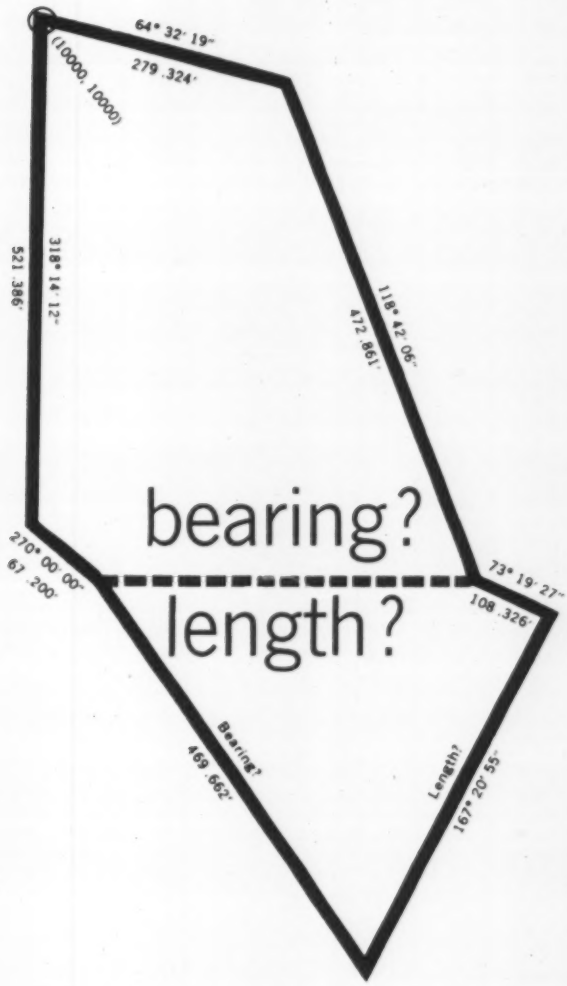
Philip Sporn recently received the first State of West Virginia Americanism Award and Citation. Mr. Sporn was named for the honor because "as head of the American Electric Power Company (New York City), he has developed technological aspects of generating electricity to produce power inexpensively enough to help attract new industries to the State of West Virginia." Mr. Sporn has also devoted time and effort to the study of nuclear energy and particularly to the possibilities of its application in the field of power generation.

Herbert F. Darling, founder and senior partner in the firm of engineering contractors bearing his name, has been elected a director of the Bank of Buffalo. Mr. Darling's contracting company maintains its offices in Williamsville, N. Y.

M. Srinivasan was recently promoted by the Indian Ministry of Railways to the post of engineer-in-chief for the Northern Railway, at Delhi. Until his promotion he was deputy chief engineer for the Northern Railway.

George Havas has been appointed vice president and director of engineering of Kaiser Industries Corporation, Oakland, Calif. As chief engineer of Henry J. Kaiser since 1935, vice president since 1945, and general manager of the Heavy Construction and the international subsidiaries since 1958, Mr. Havas has figured prominently in the various engineering and construction jobs of the Kaiser companies, including Hoover and Bonneville dams, and Fontana, the only integrated steel plant in the West.

(Continued on page 26)



solve it in seconds!

Low-cost IBM 1620 Computer frees your engineering staff for more creative work

The low-cost IBM 1620 Engineering Computer solves the traverse problem automatically, in seconds. It also balances the traverse if misclosure is within tolerance. It computes the area within the closed traverse. Versatile and fast, the 1620 can solve interdependent traverse and triangulation problems and many others not directly associated with surveys.

The time saved by the low-cost 1620 in computations like these enables your engineers to spend more time utilizing the results of surveys and less time reducing raw data to usable form.

A readily adaptable survey analysis program has been developed by IBM and will be available without cost later this year. This is another example of Balanced Data Processing, machines supported by a complete range of services. Ask your IBM representative about the advantages of the 1620 and how they can be put to use in your operation. Like all IBM Data Processing equipment, the 1620 may be purchased or leased.

The IBM 1620 is a low-cost, desk-size engineering computer with features previously found only in larger systems. It offers solid state design, magnetic core storage and high-speed internal computing performance. Its versatility and ease of operation recommend it for such engineering applications as highway cut-and-fill calculation, bridge design analysis, earthwork design and many others.

BALANCED DATA PROCESSING **IBM**

VERSATILE

. . . form round concrete columns, piers, or posts in any type structure

Wherever round concrete columns are specified . . . in buildings, bridges, overpasses, or any structure . . . SONOTUBE Fibre Forms can do the job, and do it faster and more economically than any other method.

Use SONOTUBE Fibre Forms for full-round, half-round, quarter-round, and obround columns; for pilasters; and for encasing existing structural members with concrete. They are low in cost and easy to place, brace, pour and strip . . . save time, labor and money on the job!

Choose the type that meets your requirements most economically:

1. "A" Coated—standard form for exposed columns.
2. Seamless—premium form for finished columns.
3. "W" Coated—for unfinished or unexposed columns.
4. Encasement Form—for concrete encasement of existing posts, piles, utility lines, etc.
5. Special—for use in water or excessive dampness.

Sonoco SONOTUBE Fibre Forms are available in standard 18' lengths or specified lengths . . . sizes 2" to 48" I.D. Can be sawed.

Job illustrated: U.S. Rt. #25 Overpass over Keowee Street, Dayton, Ohio, Contractor: Maxon Construction Company, Engineer: Howard, Needles, Tammen & Bergendoff.

See our catalog in Sweet's

For complete information and prices, write

SONOCO
Construction Products

4944

SONOCO PRODUCTS COMPANY, HARTSVILLE, S. C. • La Puente, Calif. • Fremont, Calif. • Montclair, N. J. • Akron, Indiana • Longview, Texas • Atlanta, Ga. • Brantford, Ont. • Mexico, D. F.

Anson D. Marston, until recently deputy division engineer in the Missouri River Division Office of the Corps of Engineers, begins a new career in September as professor of engineering at the University of Omaha (Nebraska). His professional experience is balanced between private industry—from 1926 through 1940 he was an industrial engineer for the Kansas City Power and Light Company—and government service.

Robert J. Fleming, an officer in the Corps of Engineers since 1928, will leave his post as Commanding General, Theater Army Support Command, Europe, in November to become division engineer of the Corps of Engineers' Southwestern Division, Dallas. Prior to his European assignment, General Fleming served for two years as New England division engineer.

Walter G. Schulz will retire on November 15 as chief of the Division of Design and Construction of the California Department of Water Resources, ending 30 years of state service. He plans to join the engineering consulting firm of Leeds, Hill, and Jewett, Inc., of Los Angeles, as vice president in charge of the firm's new office in San Francisco. Mr. Schulz has been responsible for the construction of the Feather River and Delta Division

W. G. Schulz

H. G. Dewey, Jr.

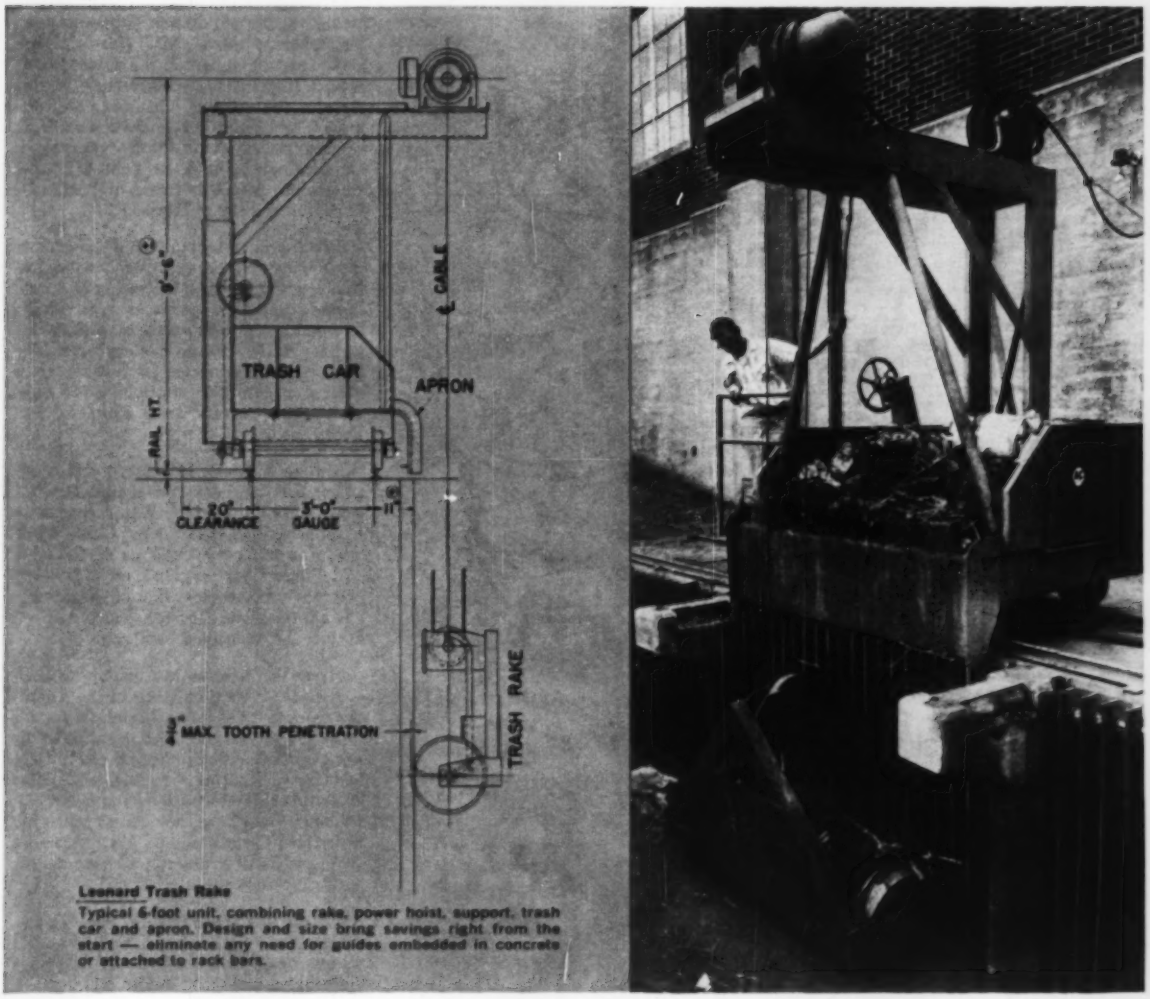
Projects, as well as other important construction work for the state. After his retirement **Haywood G. Dewey, Jr.,** who is currently serving as assistant division chief, will become acting division chief. Mr. Dewey's experience includes six years with the Bureau of Reclamation at Denver, and duty with the Corps of Engineers in Mississippi, Chicago, and San Francisco. He joined the Department of Water Resources in 1959 as chief of the Special Activities Branch.

Robert J. Macur has been appointed an engineer in the Manufacturing Department of the Amoco Chemicals Corporation, Chicago, Ill. He was previously employed in the General Engineering Department of the Standard Oil Company (Indiana) at Whiting.

Edmund A. Prentis, consulting engineer of Spencer, White & Prentis, Inc., and former president of the firm, has been appointed chairman of the heavy construction industry for the 1960 volunteer fund-raising campaign of the New York State Citizens Committee for the Public Schools. Through field services and an information exchange program, the committee helps local citizen school groups in New York State work to strengthen their school programs. Mr. Prentis is a former Director of ASCE.

(Continued on page 28)

ALLIS-CHALMERS



Leonard Trash Rake
Typical 6-foot unit, combining rake, power hoist, support, trash car and apron. Design and size bring savings right from the start — eliminate any need for guides embedded in concrete or attached to rack bars.

Cleans up costly head losses

. . . rakes-in savings enough to pay for itself!

Here's intake-trash removal so far ahead of hand methods that *"once sold is sold forever!" Leonard* trash rake installations deliver savings both in reduced head loss and labor costs. And they bring a permanent solution to shortages of people to do the job — make trash removal a one-man operation.

Leonard trash rakes roll right down your existing rack bars whether vertical or inclined. Because no channel guides are needed, they freely ride over stubborn obstructions, dig them loose, scoop trash up to the waiting receptacle or car. Self-dumping units also are available—both log-grapple and regular models.

Leonard is an Allis-Chalmers trademark.

With Allis-Chalmers trash rakes even the initial investment is low. Width is held to the logical minimum required for adequate handling of trash . . . standard 6- and 8-foot sizes. Larger units special. Your nearby A-C representative has full details. Or write **Allis-Chalmers,** Hydraulic Division, York, Pa.

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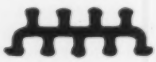
And Water Seals water stops have more miles of proved performance, too! This record, plus the ease of application and the broad variety of shapes and sizes of Water Seals water stops are all the proof you need of their desirability for your own concrete jobs. If you are after truly water-tight sealing between successive concrete pours, be sure to specify Water Seals water stops. They stand up under high temperatures and heads, even under extremes in shifting and stretching. They are unaffected by acids, alkalies, organic chemicals. Full engineering data and dimension drawings available immediately. Use the coupon.



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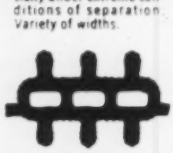
FLEXSTRIP
Water Stops. For horizontal or vertical construction joints, especially under extreme conditions of separation. Variety of widths.



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Robert H. Harrison, after 48 years of service in the U.S. Bureau of Public Roads, retired on July 31. Since 1920 Mr. Harrison has been associated with Region 4, which embraces Illinois, Indiana, Kentucky, Michigan, and Wisconsin, and since 1947 he has been regional engineer. A pioneer in the building of expressways in the Chicago area, Mr. Harrison has played an active part in the development of such Region 4 freeways as the Congress Street, Edens, and Calumet Expressways. The important interstate route from Chicago to Detroit is another example of his accomplishments. In February 1956, he received the Department of Commerce Exceptional Service Award.

Edward F. Koenig, vice president of the Engineering Service Corporation, Los Angeles, announces the opening of a civil engineering office at Santa Ana, Calif., to handle the company's expanding activities in the Orange County area. The firm, which specializes in hillside engineering, is currently developing 365 acres of hillside property in Orange and San Diego counties.

Marvin R. Lindorf, formerly senior engineer for the Port of Oakland (Calif.), has joined the staff of Water Resources Engineers, Inc., at Berkeley, Calif. While senior engineer for the Port of Oakland, Mr. Lindorf was engaged on a $17,500,000 program for expansion of the Metropolitan Oakland International Airport, harbor and industrial facilities.

Harry C. Plummer was honored recently with the Award of Merit of the American Society of Testing Materials for his long-time constructive participation in the work of its building materials committees and for promoting the use of ASTM standards by architects and engineers. Mr. Plummer has been associated with the Structural Clay Products Institute since 1937, and is now director of engineering and technology there.

Conrad W. Stout is assisting with development of the physical plant and plant engineering services at Lafayette College as assistant to the treasurer in an administrative change "in the interest of convenience and efficiency." A 1954 Princeton University graduate, Mr. Stout held engineering posts with the Pennsylvania Railroad and the Turner Construction Company before joining the administrative staff at Lafayette.

Ralph C. Graber, a career engineer officer in the U.S. Public Health Service, Washington, D. C., has been named chief of the Service's Air Pollution Engineering Program. He succeeds **Frank Tetzlaff** who has accepted an assignment with the International Cooperation Administration as sanitary engineering adviser to the Ministry of Health in Lima, Peru. Another long-time staff member of the USPHS, **Arve H. Dahl,** has been assigned to a year's tour of duty and training at the Industrial College of the Armed Forces in Washington after four years with the Water Supply and Pollution Control Division.

(Continued on page 108)

. . . . . *Am-Soc Briefs*

▶ ▶ Success story. . . . Joy reigned at Society headquarters on August 17 at word that ASCE had gone over the top in its campaign for $800,000, its share in fund raising for the United Engineering Center. As the oldest national engineering society, it is fitting that ASCE should be the first of the original Founder Societies and the second of the major engineering groups to achieve its goal. The Society's participation in the UEC project is discussed in the "ASCE News" lead, this issue. Official statistics on the ASCE drive will be reported in October.

▶ ▶ The Karl Terzaghi Award. . . . What may well become one of the premier Society awards is being established in honor of Prof. Karl Terzaghi, Honorary Member of the Society, three times winner of the Norman Medal, and a pioneer in the field of modern soil mechanics. The award — to be announced on October 11, during the Boston Convention — will be given once every three years for outstanding contributions to soil mechanics and foundation engineering appearing in any of the Society's publications.

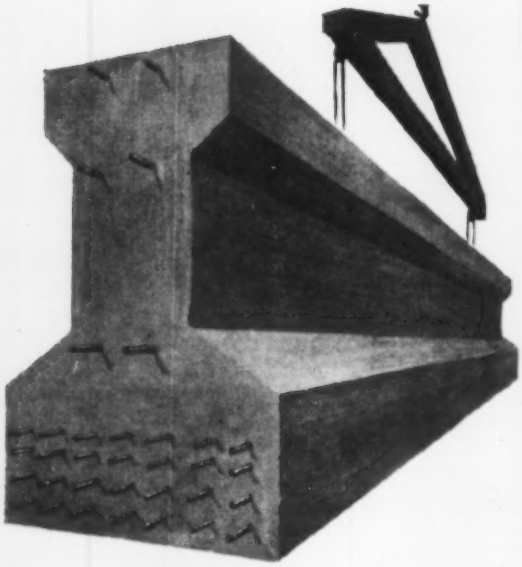
▶ ▶ Be on the lookout for a mailing on the ASCE Group Life Insurance Plan (page 75). The newly approved plan, which has been in effect since March 1, 1960, closes its charter enrollment period on October 31.

▶ ▶ New ASCE Salary Index. . . . The Society's Salary Index changes this month to provide figures as of July 30. It will be noted (page 55) that pay rates for civil engineers show uptrends in eight of fifteen U.S. cities. Reversals are noted in Atlanta, Miami, and Portland. These observations are based on analyses of data provided semiannually by a picked group of respondents. Trends in major cities are computed from data supplied by leading consulting firms. Regional figures are based on reports from state highway departments.

▶ ▶ The California Council of Civil Engineers and Land Surveyors is supporting fully the ASCE stand that surveying and mapping is professional work. The California group has added to its canon of ethics a prohibition on bidding on such work, to be in effect not later than September 1, 1960.

▶ ▶ The Directory of Membership is being distributed. . . . If you are one of the thousands who have not received the copy due you because you forgot to ask for it, better take a minute now to fill out and return the coupon on page 124. The 1960 Directory is your best chance to find out what your friends and fellow engineers are doing and where they are living and what members are listed in your own city. The next move, members, is up to you! (P.S. It takes a little time for delivery, as mailing is being handled by the printer.)

FULL LINE OF DEPENDABLE *Richmond* PRODUCTS FOR EVERY KIND OF PRESTRESSED CONCRETE MEMBERS *saves time & money safely!*

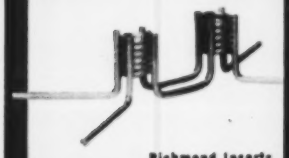


Richmond, to meet growing demands created by the continually increasing use of prestressed concrete, has developed a full line of dependable, quality-tested strand deflectors, lifting inserts, void supports, anchors, all types of threaded inserts, form hangers and accessories for prestressed concrete beams, piles, slabs and girders.

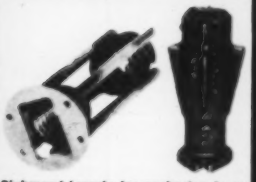
These products have been designed and engineered, with the know-how gained thru 49 years of experience, to meet the needs of new, improved techniques in strand deflection, void support, lifting of and anchoring to prestressed members.

Richmond Strand Deflection Inserts for prestressed concrete beams and girders. In addition to the standard line of inserts, special units can be manufactured to suit individual needs.

Richmond Chairs and Spacers for void supports and spirals in prestressed piles and beams.



Richmond Inserts for connection of cast-in-place diaphrams to prestressed girders.



Richmond inserts for anchoring to or hanging from prestressed members.

Richmond Extended Coil Tyscrus for lifting prestressed beams and girders. (2 & 4 strut)

Richmond Inserts for anchoring guard rails to prestressed girders.

Phillips Self-drilling Concrete Anchors for anchoring to any concrete members after the concrete has set.

Richmond Offset Free-Fit Hanger Frame-Tys used to hang forms from prestressed "I" beams.

Shown here are a few of the many Richmond-engineered products for the prestressed concrete construction industry. For more information about them, or help with any specific concreting problem, write to:

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do you know that

U.S. engineering schools spent $71 million for research and development in the fiscal year 1958? Of the total, $48.6 million came from the federal government; $10.3 million from industry; $10.5 million from their own funds, plus an additional $3.5 million from outside-sponsored grants and contracts. Of the $71 million, 57 percent went for basic research, compared to 45 percent reported in a study of research expenditures for 1954. These figures are reported by the National Science Foundation on the basis of a survey of 129 engineering schools.

▪ ▪ ▪

Sawdust is being used on a highway job in Canada? The highway—between Vancouver and New Westminster, B.C.—crosses deposits of peat and very soft clay up to 80 ft in depth. A thick layer of sawdust is placed over the peat, which is too soft to support construction vehicles, and sand is then placed on top of the sawdust.

▪ ▪ ▪

The Bureau of Reclamation is installing seismographs in the bedrock foundations of Flaming Gorge and Glen Canyon dams? The highly sensitive instruments—like similar installations at Hoover Dam and other Bureau of Reclamation projects—will keep constant watch on earth movements in the immediate vicinity of the structures. Findings will be reported on film, which will be developed and studied by the Coast and Geodetic Survey.

▪ ▪ ▪

Alaska needs 2,800 more miles of highway? Officials of the 49th state estimate that this additional mileage of primary and secondary roads will be needed to complete the state's basic road network. Estimated cost of the work is about $420 million.

▪ ▪ ▪

Explosions are being used to shape the metals in missiles? Aero-forming—a process developed by the Aerojet-General Corporation—begins with the mold, a large bowl-shaped unit. The blank metal is placed above the mold and secured. A carefully calculated charge is then placed above the blank, air is pumped from the mold (creating a partial vacuum), and the entire unit is submerged in a tank of water. The charge is exploded under water, and the force of the explosion is carried against the metal, instantly shaping it to the contours of the mold.

▪ ▪ ▪

Our steel imports exceeded our exports in 1959? For the first time in 56 years, the U.S. was a net importer of steel mill products in 1959. Department of Commerce data show that imports totaled 4,391,791 tons (more than double the former high set in the Korean War) and that exports totaled 1,507,940 tons, the lowest level since 1936. The product imported in the largest quantity was concrete reinforcing bars (nearly 852,000 tons), followed by 553,000 tons of pipe and tubing.

▪ ▪ ▪

Canadians are using big floating balls to transport river cargo? The 8-ft-dia fiber glass spheres are being used experimentally on the Fraser River to ship pulp from sawmills in the interior to paper mills at Ocean Falls and Elk Falls. Although the balls don't travel much faster than 2 mph, they are inexpensive—need no crew and no fuel—and keep their cargo dry.

▪ ▪ ▪

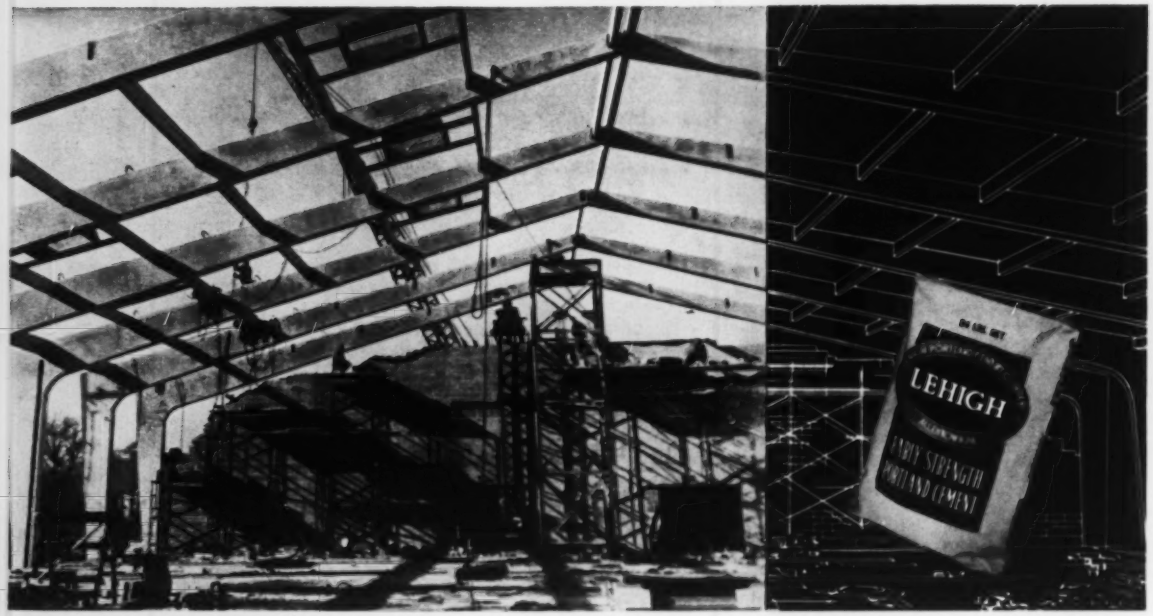
Railways are the transportation wheelhorse of Russia? In fact, they are virtually the only form of surface transportation. Water traffic is limited to a short season, and there are practically no intercity highways. Comparing the role of railroads in the U.S. and Russia, the Association of American Railroads points out that the Russian system handles one and a half times as much traffic as the American system, though it has only about one-third America's 218,000 miles of railway. With mechanization conspicuous by its absence, the key to this high-capacity performance lies in a work force of 3,500,000—four times that of the U.S. lines.

▪ ▪ ▪

Construction of a dam between Siberia and Alaska has been proposed? The project, which is a Soviet idea, would be equipped with pumping stations to draw cold Arctic water into the Pacific, and permit the Gulf Stream to flow into the Arctic and warm it. After Russian engineers made the proposal, Alaskan senators asked Washington to investigate the possibilities.

▪ ▪ ▪

This year's engineering graduates continue to find a favorable employment situation? Reporting a survey of prospective graduates made late in May, the Engineering Manpower Commission of Engineers Joint Council reveals that 62 percent had jobs, 11.3 percent were considering jobs, 8 percent were entering military service, and 10.1 percent were entering graduate study. Graduates in business and commerce and in the arts and sciences were about 10 percent below engineers in definite commitments. The full survey may be obtained from the Engineering Manpower Commission (29 West 39th Street, New York 18, N.Y.) for a handling charge of 25 cents.



Jordan Sellars High School Gymnasium, Burlington, N. C. Unobstructed floor area is 100′ by 120′. Height at center of arch is 32′.

Architect: McMinn, Norfleet & Wicker, Greensboro, N. C.

Contractor: O. G. Thompson & Sons, Burlington, N. C.

Manufacturer Precast Units: Arnold Stone Company, Greensboro, N. C.

Ready Mixed Concrete: R. F. Kirkpatrick & Sons, Burlington, N. C.

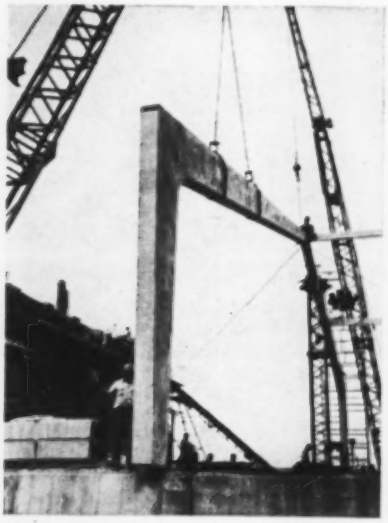
8 PRECAST CONCRETE ARCHES FRAME 100′ WIDE GYM

Lehigh Early Strength Cement Cuts Casting Time

Attractiveness, durability, fire safety and unusual simplicity—all characterize the frame of this new gym and further prove the versatility of precast concrete. The huge arches were cast on the gym floor in half sections and raised into position. Precast concrete purlins, spanning 16 feet between arches, provide lateral stability.

For fast re-use of forms in casting both arches and purlins, Arnold Stone Company used concrete made with Lehigh Early Strength Cement. To quote Mr. M. A. Arnold, "Lehigh Early Strength Cement enabled us to complete the casting operations in half the time required with regular portland cement."

This is a typical advantage of Lehigh Early Strength Cement in modern concrete construction. Lehigh Portland Cement Company, Allentown, Pa.



As one crane raised and held the 18-ton arch half, another (on the right) guided it into position. The two halves were then welded together to form complete arch.

LEHIGH CEMENTS

LEHIGH EARLY STRENGTH CEMENT • LEHIGH PORTLAND CEMENT • LEHIGH AIR-ENTRAINING CEMENT • LEHIGH MORTAR CEMENT

CIVIL ENGINEERING

From address presented before the Awards Luncheon at the ASCE Reno Convention.

POWER PARTNERSHIP AND POLITICS

RALPH A. TUDOR, F. ASCE, Partner
Tudor Engineering Company
San Francisco, Calif.

Power partnership can take many forms depending on the circumstances. All these forms, however, fit into one general pattern. In this pattern the local utilities, whether public or private, are encouraged to undertake the construction and ownership of their power generating facilities wherever possible. When the local entities cannot do this with their own resources, then superior political interests such as the state and the Federal Government should come in to assist them. Note that I use the term "assist" and do not say "take over." These various entities should participate jointly to produce the power that is necessary for the well being of the country. But the leadership and the impetus should come from the local échelon nearest the people to be served. This is the overall concept of power partnership.

Within this concept many forms are available for individual projects. One good example is the Oroville Dam, a part of the California water plan. In this instance, the State of California proposes to build the project and install the turbines, generators and other power equipment at the dam. Most of the project money will be obtained by the state from a bond issue which is to be retired by earnings from the power sold to an investor-owned utility. The Federal Government has agreed to be a partner to the extent of providing the funds for the flood control benefits. Private enterprise is to be a partner to the extent that it will transmit and market the power to be generated. Payments for the power will be sufficient to return the state's investment. Thus, in this instance, the partnership is between the Federal Government, the State of California and an investor-owned utility.

Another partnership project in California is the Tri-Dam Project. This is a series of three dams built by the Oakdale and South San Joaquin Irrigation Districts to store water for irrigation. Incident to the storage of this water, a substantial block of power is being generated. This power is sold on a fifty-year contract to the Pacific Gas & Electric Company and the funds thus derived are used to retire the bonds which were sold to provide the capital to build it. In this instance, the partnership is between two irrigation districts and a local investor-owned utility. Neither the state nor the Federal Government participated.

On the Merced River in California, another partnership arrangement is being worked out. Here, the Merced Irrigation District proposes to build three dams, primarily for the storage of water for irrigation. Incident to this, a large block of power will be generated. Here again the power will be sold to the Pacific Gas & Electric Company on a fifty-year contract and the revenues from the sale will largely pay for the construction of the dam and the power plants. A third party to the partnership will be the Federal Government. Federal legislation is now being processed that will result in the Federal Government's supplying funds on the basis of flood control benefits to be derived from the storage of water in the reservoirs. Here the partnership arrangement is between the Federal Government, a local irrigation district, and an investor-owned utility. The state is not a member of the partnership.

You may recall the Hells Canyon arguments extending from the mid-1940's until about the mid-1950's. Here, a local investor-owned utility was willing and able to build dams to generate all the power within a stretch of the Snake River. Some agencies and officials of the Federal Government had opposed this violently and proposed to build a large federal dam. For several years, and in spite of strenuous pressures brought to bear, Congress never appropriated money for the project. The Department of the Interior had no authority to proceed with its plan. Without Congressional approval, however, the Department of the Interior went into the courts and endeavored to prove that the Federal Power Commission was without authority to grant a license to the local utility. This was done in spite of the fact that the Supreme Court had already ruled in a similar case that the Federal Power Commission had full authority in the matter.

Taxes from utilities

This bottleneck was broken in 1953 when the Department of the Interior discontinued its efforts to circumvent the authority of the Federal Power Commission. The net result was that the investor-owned utility has now proceeded to build this project at no cost to the Federal Government. Furthermore, the utility will pay heavy taxes to the Federal Government, to the State of Idaho and to lesser political subdivisions. None of these benefits would have been received had the Federal Government built the project. In this instance, there is only one partner involved, although simply by its acquiescence, the Federal Government may be classed as a partner.

Any discussion of the partnership policy in this geographical area would be incomplete without some mention of the Trinity Project in California. Here the Federal Government is now building a dam for the storage of water for irrigation and other incidental purposes. The local investor-owned utility offered to buy the falling water and generate power for its state-wide distribution system. This power would then be sold under the regulations of the California Utilities Commission. In this instance, the Department of the Interior recommended to the Congress that the offer be accepted. It was shown that by so doing, the Federal Government would be saved a multi-million dollar investment and that furthermore, various political entities would collect very substantial taxes which they would not obtain if the Federal Government built the project. Nonetheless, the Congress rejected this partnership proposal and the benefits which it contained, and directed the Bureau of Reclamation to make the power installation. This was a violation of the partnership concept and is regrettable.

In numerous instances throughout the United States, projects have been built by the Federal Government with provisions for the installation of generating units by others. In these cases, the falling water was customarily sold to investor-owned utilities and these utilities installed the turbines and generators at their own expense and in accordance with a Federal Power Commission permit. One such project in California is the Narrows Dam. Here the Federal Government built the project but the license to install generating equipment was issued to the Pacific Gas & Electric Company. For this privilege, the utility pays for the falling water and retails the power produced at rates approved by the California Utilities Commission.

In fact, the Federal Government has participated in a very substantial number of partnership projects in the past. The first one was carried out in 1908 under the administration of Theodore Roosevelt. In every administration since that time, regardless of the political party in power, there have been new examples of federal participation in partnership projects for the generation of power and other benefits. This is ample proof that such partnerships can work.

Nevertheless, during the 1930's and 40's the Federal Government showed an increasing inclination to move deeper into the power field without the participation of local partners. More and bigger hydro projects were built where the Federal Government undertook not only the construction of the facilities, complete with turbines and generators, but also the power-transmission facilities. More than that, it actively undertook the creation and support of local public utility districts and rural electrification bodies that served as agents for the retailing of federal power and were very effectively tied to the apron strings of the Federal Government through the mediums of loans, power contracts, etc.

I feel strongly that this concept had the direct result of denying the residents in the areas served the power to regulate their own business and destiny. It is not the American way of life, which means so much to so many of us.

The answer to this was a vigorous effort to encourage the partnership concept. The Bonneville Power Administration, for example, was directed to discontinue its propaganda to influence what the local people might want to do and to direct all its energies to being, in fact, a utility serving the area. Furthermore, this effort was directed to serve all the people fairly and impartially and not selected and preferred segments.

Local interests were informed that the Federal Government would support partnership projects. It was quickly demonstrated that the local bodies were quite capable of financing and building much of the generating capacity. Already some of the very largest plants on the Columbia River have been completed and several more are under way as a result of local effort.

In 1950 some 70 percent of the projects under construction in the Pacific Northwest were federal and only 30 percent were locally sponsored. In this year of 1960, the federal responsibility for projects under construction has been reduced to 43 percent and local interests are now responsible for the remaining 57 percent. If this partnership program is permitted to continue, the proportion of local effort will continue to increase. This is true because many of the projects still under construction by the Federal Government are ones for which commitments were made many years ago.

Power shortage remedied

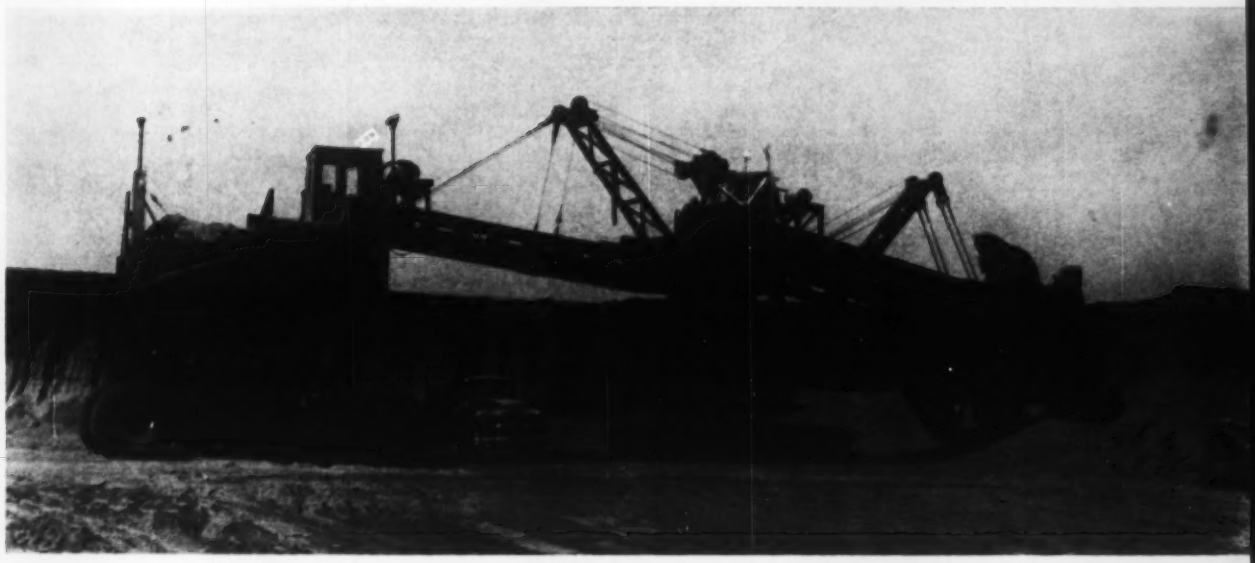
In 1950, and the years immediately following, there was a serious shortage of power in the Pacific Northwest. Frequently there were brownouts, and industrial power consumption was often curtailed. Today there is no shortage of power in the Pacific Northwest and there is thought of exporting some of the surplus to California. The picture is very substantially changed and all for the better in the area concerned.

Elsewhere in the nation, with the general exception of the Tennessee Valley area, a comparable change has been effected.

This partnership concept in power generation and distribution is a very fundamental matter to each of us as citizens. If we go in the direction of federal domination, with remote controls in Washington, the local areas lose their identities, their responsibilities, and to a large extent the control of their own destinies. They must then humbly beg for aid and appropriations from Washington at every turn.

The partnership concept has the opposite effect. It permits the people in an area to determine their own destinies and to proudly go their own way. Only when the problems become more than they can handle do they seek higher aid, and then it is given on the basis of help and assistance rather than on the basis of sacrifice of a birthright.

The "wheel" operates against a face up to 20 ft high, excavating from 2,000 to 3,600 cu yd per hr. Buckets discharge through a cone to a belt that feeds overhead belt conveyor.



NEW TOOLS FOR EARTH-DAM CONSTRUCTION

PAUL H. DUNAWAY, M. ASCE, Engineer, Albuquerque District

Corps of Engineers, U. S. Army, Albuquerque, N. Mex.

A wheel-type excavator for quantity borrow-pit work is moving a lot of earth for Abiquiu Dam in New Mexico. The machine was developed through the ingenuity of Mittry Construction Company, contractor for the embankment and spillway portions of the dam. The new tool is of a size suitable for the high quantities of earth borrow needed in major earthfill dam construction. An independently operated traveling hopper moves with the machine to load trucks.

The contractor on Abiquiu also developed a novel water-injection method to efficiently increase the moisture content of borrow while dumping it

This newly developed wheel-type excavator with an independently operated traveling hopper provides a unique means of borrow-pit excavation for Abiquiu Dam.

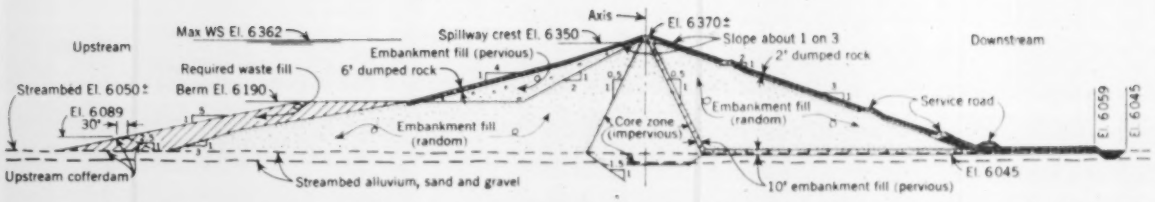


FIG. 1. Typical stream-bed section through Abiquiu Dam on Chama River, New Mexico. Primary formation under dam consists of clay, shale, siltstone and sandstone.

into trucks. This replaces the conventional wetting and processing on the embankment or the pre-wetting of borrow areas to raise the moisture from about 3 to 12 percent.

Abiquiu Dam, a flood control project of the U. S. Army Corps of Engineers, under construction on the Chama River approximately 35 miles above Espanola, N. Mex., is an earthfill structure; it will be about 1,450 ft long and 2,700 ft wide at the base. Rising 325 ft above the stream bed, it will be the highest of all the earthfill dams so far constructed under the supervision of the Corps of Engineers. See Fig. 1.

Excavation of 12 million cu yd

Construction of the embankment requires excavation of about 12,000,000 cu yd of impervious, pervious, and random materials from borrow areas located an average of 1.7 miles from the dam site. The various materials are obtained by selective borrow excavation.

The few wheel-type excavators previously used were developed for coal stripping work as done in the Mid-West. One of these huge earth movers weighs well over 2,000 tons. It has a capacity of 3,500 cu yd per hour and can work against a 100-ft face. These machines are not adaptable to borrow excavation because of their massiveness and limited mobility.

The compact, highly mobile wheel-type excavator developed for use on Abiquiu Dam has a favorable prospect for use on other projects where large quantities of earth embankment are involved. The excavator is constructed around a 4-cu yd Lima Shovel, Model No. 1601, modified for this particular use, and weighs about 175 tons. The wheel, mounted on the end of a specially constructed boom, is 12 ft in diameter. See Fig. 2. It is equipped with six modified 1¼-cu yd Esco buckets and is designed to operate at speeds up to 10 rpm. The truncated cone that forms the center of the wheel is an integral part of the wheel. It functions as a support, providing a bearing area on the shaft for one side of the wheel.

Power for traction and for operating the wheel is provided by a Cummins V12, 365-hp diesel power unit, the standard unit for the Model 1601 Lima shovel. Power for the wheel is taken from the crowd chain drive by a double chain and transferred by a pinion to a bull gear located on the left side of the wheel.

Excavated material falls from the buckets onto a collecting belt 5 ft wide, operated at 540 fpm. This transfers the material to an articulated two-section belt conveyor projecting beyond the rear of the cab and discharging into an independently operated traveling hopper.

The hopper, of 30-cu yd capacity, is mounted on a four-wheel chassis with 24.00 x 25 tires. A 150-hp GM diesel power unit, also mounted on the hopper chassis, provides vehicular power for moving the hopper and for steering. It also supplies power for a 5-ft-wide belt conveyor used to transfer material from the hopper to bottom-dump trucks. All controls are operated from a cab, located above and to one side of the hopper.

The wheel excavator can work a face up to 20 ft high with a maximum horizontal swing of 180 deg. It digs at a rate of 2,000 to 3,600 cu yd per hour, depending on the physical characteristics of the undisturbed material.

The excavator conveyor and collecting belts are electric-motor driven, the power being provided by a 290-hp diesel-driven, 150-kw GM generator located in the rear of the cab.

Bottom-dump trucks of 22-cu yd capacity haul the borrow to a loading hopper located near the general borrow area. Here a vibrating scalper re-

A conveyor 4,300 ft long carries fill material to a loading hopper near the dam. The dam, 2,700 ft wide at the base, will rise to a height of 325 ft in the canyon.

moves oversize material as the borrow falls onto a 6-ft-wide belt that feeds a belt conveyor 4 ft wide and 4,300 ft long. The latter discharges material into truck-charging receiving hoppers located near the dam site.

Material from the belt may be discharged directly into one hopper or diverted over a shaker screen, when necessary for closer control of fines. At least 40 percent passing the No. 200 sieve is required for impervious material; not more than 8 percent passing the No. 200 sieve is permitted for pervious material. Movement of materials between the loading and discharge hoppers is controlled by an operator in a small tower at the loading end. As a check on the acceptability of the materials moved, a scale built into the main belt conveyor system automatically records the weight of the material on a barogram in the control tower.

Moisture problem solved

Moisture content of the fine-grained borrow material as it reaches the receiving hoppers is approximately 3 percent. This must be increased to about 12 percent to conform to the specification requirements of not more than 2 percent above, or 1 percent below, optimum.

To uniformly increase the moisture content, the contractor has developed a system for automatically injecting water into the material as it is discharged from the receiving hopper into bottom-dump trucks for the short haul to the embankment area. Two rows of spray bars, consisting of five 4-in. bars per row and connected to a manifold, are located below a hydraulically operated discharge gate of roller-belt type. Each spray bar contains a solenoid valve actuated by the movement of the gate so that a spray is produced only as each bar is cleared by the gate and the material is discharged.

Even distribution of discharged material between the bars is provided by "splitters" located immediately above each spray bar of the top row. Holes drilled in each bar at an angle of 45 deg above the horizontal were found to produce the most effective wetting. This also prevents drip draining and the introduction of air into the bars when they are not discharging.

Controls for the system are automatic to the extent that each driver, after spotting his truck under the hopper, merely pulls a cord. This actuates a cycle that opens the gate, injects water into the material being discharged, and closes the gate at a predetermined time depending on the capacity of the truck. The cycle requires about 7 seconds for loading an 18-cu yd truck.

Spray bars are checked at the beginning of each work shift and each one is manually balanced as necessary to provide uniformity. Manual controls in the manifold supply line, which is maintained at a pressure of about 47 psi, provide a means of adjusting flow to compensate for fluctuations in the moisture content of the various materials.

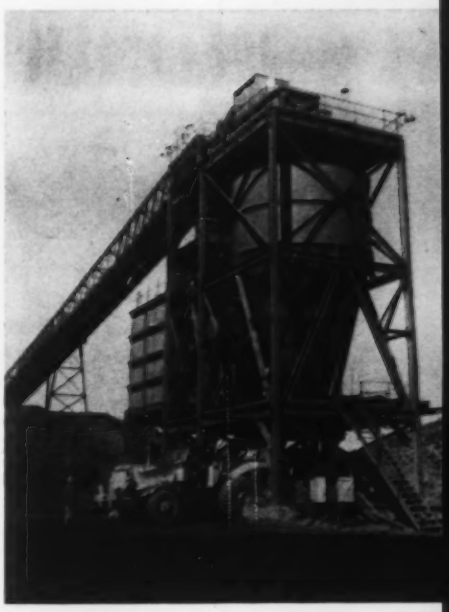
Tests are frequent

Field laboratory personnel make moisture determinations at the rate of not less than one per hour; tests of density in place are made on the average of one per each 3,000 cu yd placed to maintain control of moisture content and compaction of material incorporated into the embankment. Specifications require four complete passes of a rubber-tired roller loaded to a 50-ton weight over each 9-in. lift of impervious or 12-in. lift of random material. Provision is made for additional rolling as necessary to obtain a density of 95 percent of maximum as determined by standard AASHO test procedures. Densities up to 100 percent of maximum have been readily attained without additional rolling.

Supplemental watering, additional mixing, or aerating of borrow material placed on the embankment is practically never necessary because of the ease of control and the uniformity with which the moisture is distributed. This system of increasing the moisture content of soils has resulted in an exceptionally well regulated embankment operation.

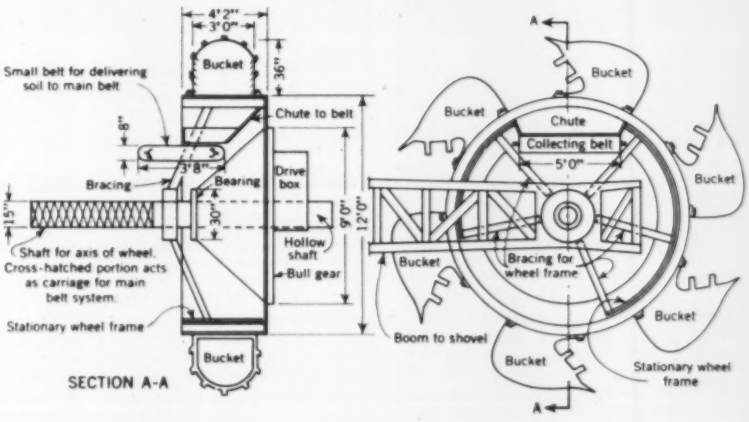
Construction of the Abiquiu Dam is being administered by Col. Albert L. Reed, District Engineer of the Albuquerque District, U. S. Army Corps of Engineers. Don H. Wilson is the Resident Engineer.

Contractor personnel on the project includes F. K. Mittry, Jr., president of Mittry Construction Company, Los Angeles, Calif.; and Jack Starkey, Project Engineer.



The 4,300-ft belt conveyor terminates at receiving hoppers near the embankment area. Here moisture content is increased by uniformly injecting water into the material as it is discharged into trucks.

FIG. 2. New-type excavator is equipped with bucket wheel 12 ft in diameter. It carries six modified 1 1/4-cu yd Esco buckets and is designed for operating speeds up to 10 rpm.



CONTINUITY IN PRECAST BRIDGES

LABORATORY TESTS OF A TWO-SPAN CONTINUOUS PRECAST-PRESTRESSED BRIDGE

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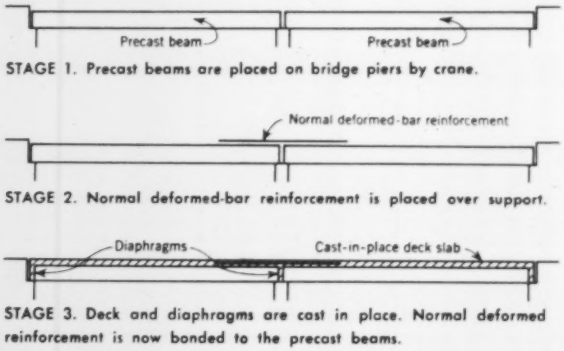
Tests of a two-span, continuous, precast-prestressed concrete bridge constituted the final stage of an extensive investigation of prestressed bridges consisting of precast girders made continuous by conventional deformed-bar reinforcement placed in the cast-in-place deck slab. The bridge test was preceded by eight experimental projects involving studies of individual members, all at the Portland Cement Association Laboratories.

In recent years, the precast-prestressed concrete girder combined with a cast-in-place deck slab has become a highly competitive form of highway bridge construction. However, the majority of bridges constructed in this manner have consisted of a series of simple spans. With the hope of improving still further the position of prestressed concrete in the highway-bridge market, it was decided to investigate possible methods of creating continuity between adjacent spans of precast-prestressed concrete bridges in order to team together the advantages of precast-prestressed concrete and continuous construction. Several forms of continuous connections were considered, and it was decided to investigate in detail that form in which continuity is created for live loads only, by the embedment of deformed reinforcing bars longitudinally in the cast-in-place deck slab over the interior supporting piers. This method of creating continuity has been used extensively in Europe. It has also been used in American prestressed bridge construction to eliminate joints between adjacent spans, although in most cases, the full structural design advantages of continuity have not been utilized.

The sequence of construction when this form of continuity connection is used is shown in Fig. 1. The precast girders are placed on the bridge piers with their ends about 6 in. apart. Formwork for the deck slab is then erected, being supported by the girders. Conventional deformed reinforcing bars are next placed longitudinally in the deck slab over the intermediate piers. The transverse diaphragms that enclose the ends of the girders and fill the space between them are then concreted. The deck slab is concreted later.

The dead weight of the structure is supported by the precast girders acting alone as simply supported spans. After curing of the concrete of the deck slab and diaphragms, the composite structure acts as a series of continuous spans when subject to external loads. At the midspan sections, the bending moments are resisted by the precast girders and the cast-in-place deck slab acting together as composite prestressed T-sections. At the intermediate supports, the bending moments are resisted by the conventional deformed reinforcement acting with the concrete of the bottom flange of the precast girders as a reinforced concrete section. Over the entire length of the bridge, the horizontal shearing strength between the deck slab and the precast girder is obtained by a combination of stirrups projecting into the slab from the roughened top face of the girder, and of bond between the slab concrete and the top face of the girder.



STAGE 1. Precast beams are placed on bridge piers by crane.

STAGE 2. Normal deformed-bar reinforcement is placed over support.

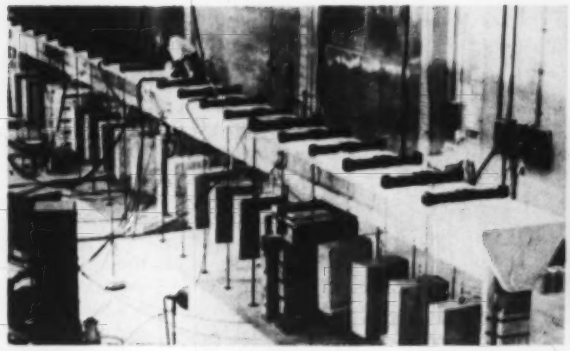
STAGE 3. Deck and diaphragms are cast in place. Normal deformed reinforcement is now bonded to the precast beams.

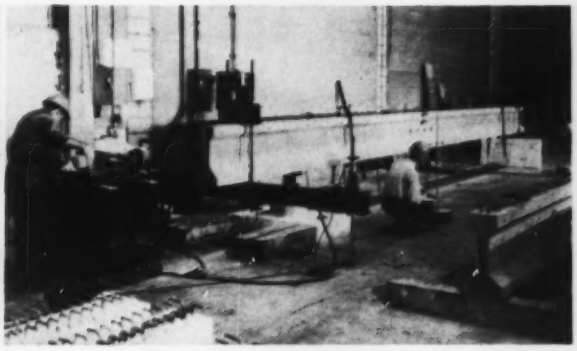
FIG. 1. Precast continuous bridge was constructed in three stages. Continuity was created for live loads only by the embedment of deformed reinforcing bars longitudinally in the cast-in-place deck slab over the interior supporting piers.

Experimental program

The form of construction described gives rise to several questions regarding the properties of structural concrete not covered by previous tests. The first of these questions relates to the performance of this type of connection between precast girders when subject to static loads. Specimens were tested that consisted of precast-prestressed girder stubs joined together by conventional deformed reinforcing bars placed in a deck slab cast on top of the girder stubs. The specimens were supported under the connection and loaded at each end.

A wide range of variation in the amount of continuity reinforcement was combined with variations in maximum precompression in the bottom flange of the precast girders of from zero to 3,200 psi. From a study of the measured and calculated ultimate strengths of the connections tested, it was concluded that, for the practical range of continuity reinforcement of from 0.5 to 1.5 percent, the influence of precompression of the bottom flange of the girders can be neglected in the calculation of the ultimate strength of this type of connection.





A test was made of a half-scale model of one continuous girder taken from the design-study bridge. Concrete blocks, each weighing 800 lb, were hung from the girder at 3-ft intervals so that stresses in the one-half-scale structure, before live loading, would be the same as dead-load stresses in the full-scale structure. In torsional-stiffness tests, above, girders were clamped at one end, and a torque applied at the other end by two rams acting on a crosshead attached to the end of the girder.

The percentage of continuity reinforcement, p, is calculated on the basis of the width of the girder bottom flange, b, and the distance from the centroid of the continuity reinforcement to the bottom face of the girder, d, that is,

$$p = A_s/bd$$

Fully composite action of a precast girder and a cast-in-place deck slab depends on the effective transfer of horizontal shear between the girder and the slab. An experimental study was therefore carried out with the object of evaluating the effectiveness of various means of horizontal shear transfer. Test results indicated that horizontal shear strength can be obtained as previously described without the use of shear keys. The complete results of this phase of the investigation are reported in detail elsewhere.[2]

On completion of the first two stages of the investigations, a tentative design was prepared for a precast continuous highway bridge to carry the AASHO Standard H20-S16 loading over two spans of 66 ft each. The salient features of the bridge are shown in Fig. 2. The deck slab is 6 in. thick, and the Type III AASHO-PCI standard bridge girders are set 6 ft 6 in. on centers. Diaphragms are provided only at the support sections. Draped prestressing strands were not used. Design criteria for the continuity connection and for the horizontal shear connection were based on data obtained in the first two stages of the investigation.

As far as possible, all other phases of the design were carried out in conformity with the AASHO "Specifications for Highway Bridges," or in accordance with the recommendations of the ACI-ASCE Committee on Prestressed Concrete. The center support section was designed to have an ultimate strength of

$$2.5\ (M_{LL} + M_I)$$

and the midspan sections were designed for

$$2.5\ (M_{LL} + M_I) + 1.5\ M_{DL}$$

The design studies indicated a need for additional test data and further stages of the investigation were planned. These covered: (1) the shearing strength of the continuous girders in the region of the intermediate supports; (2) the influence of creep in the precast-prestressed girders and of differential shrinkage between the girders and the slab on the continuity behavior of the continuous girders after an extended period of time; and (3) the behavior of this type of connection when subject to repeated loading. The tests in all these studies were carried out on half-scale models of girders with their portion of deck slab taken from the bridge considered in the design study. The results will be reported in a series of PCA Development Department Bulletins and it will only be mentioned here that, in one of the tests, a connection of the type proposed withstood ten million repetitions of 1½ times the design service moment without failure.

As a supplement to the first stage of this investigation, a half-scale model of one continuous girder taken from the design-study bridge was subjected to loads simulating the H20-S16 equivalent lane loading, arranged so as to produce maximum moment at the interior support. The girder behaved in a very satisfactory manner, full redistribution of bending moments being attained at ultimate strength.

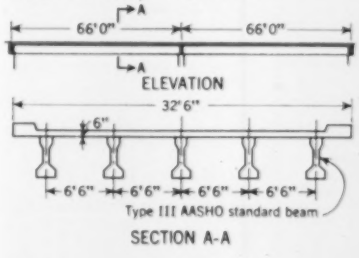
When a structure is reproduced to scale, the dead weight stresses in the model decrease in proportion to the scale of the model. It is therefore necessary to supply additional dead weight to the structure if the permanent stresses in the model are to be the same as those in the full-scale structure. In this case, 800-lb blocks of concrete were suspended from the precast girders at 3-ft intervals before the deck slabs were cast, since the precast girders carry the entire dead weight in the full-scale structure.

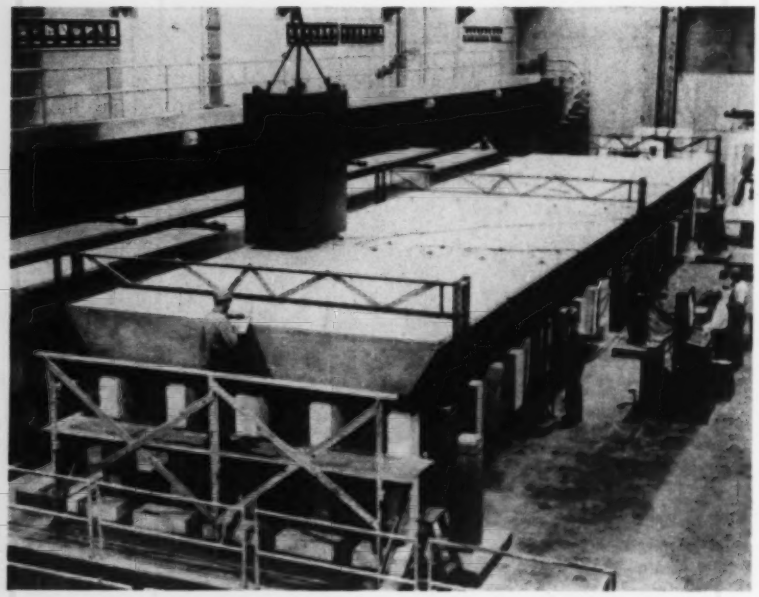
Half-scale model tested

The final stage of this experimental program was the test of a complete half-scale model of the bridge considered in the design study. The ten half-scale Type III AASHO-PCI standard prestressed girders 33 ft 6 in. long used in the structure, were each prestressed by twenty-eight ¼-in. strands initially tensioned to 175,000 psi. The girders were made in pairs several months before the bridge was to be constructed, so that, at the time of the tests, they would be as nearly equal as possible in strength and stiffness.

Before the bridge was constructed, the girders were tested individually to determine their flexural and torsional stiffnesses, which were found to vary only about 10 percent. In the flexural-stiffness tests the girders were simply supported on 33-ft spans, and were loaded equally at two points located

FIG. 2. Precast-prestressed continuous bridge used for design studies.



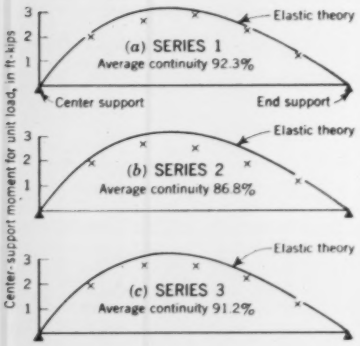


The continuity behavior of the bridge was tested by placing two 10,000-lb blocks of concrete singly or paired at fifty points on the bridge deck. Measurements of reactions, deflections and strains were made before and after applying the loading blocks at each loading point.

4½ ft on each side of the midspan point. The loads were increased in increments, and measurements were made of flexural strains and deflection at midspan at each load stage.

In the torsion-stiffness tests, the girders were clamped at one end, and a torque was applied at the other by two rams acting on a crosshead attached to the end of the girder. The torque was increased by increments and the twist was measured over a length of 20 ft. Good agreement was found between the calculated and measured values of flexural and torsional stiffness.

FIG. 3. Influence lines for total moment at center support show continuity behavior of the bridge in three series of tests.



The first stage in the construction of the bridge was the erection of the precast girders on the supporting columns. One hundred blocks, necessary for correction of the permanent stresses in the model structure, were hung from the girders. The formwork for the deck slab was next erected, being supported by the precast girders. Subsequently, the continuity reinforcement and the normal deck reinforcement were placed.

Tests at service-load level

Testing of the bridge took place in two stages. First, tests were carried out at service-load level to check the continuity behavior of the structure, and also to investigate the extent of transverse distribution of concentrated loads applied to the bridge deck.

In these tests, the bridge was loaded by placing two 10,000-lb blocks of concrete singly or paired at 50 points on the bridge deck. The blocks were placed in position using an overhead gantry crane with a vernier speed control, and rested on a Fabrika pad 1 ft square on the bridge deck. The loads applied to the model structure were equivalent to loads of 40,000 or 80,000 lb acting on the full-scale structure.

Measurements of support reactions, midspan deflections and flexural strains at midspan and support sections, were made immediately before and after applying the loading blocks at each loading point, so as to eliminate zero drift problems in the electrical-resistance strain gages. Deflections were measured using dial gages graduated in ten-thousandths of an inch, mounted on independent Dexion angle frames. The gages were placed under the bridge at midspan and above the bridge at the supports. The reaction at the end of each girder was measured by an electrical-resistance-gage load cell.

The readings of the strain gages and load cells were made using a Datran self-balancing strain-gage bridge operating through a series of switch boxes. The time taken to locate the loading block and to take the 140 readings of reactions, strains and deflections associated with each position of the load was approximately 15 minutes.

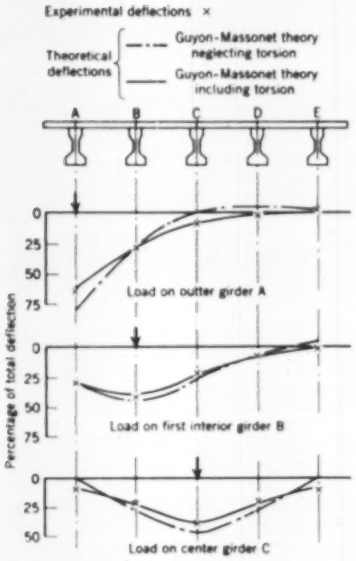
Three series of tests were made using the concrete loading blocks. In Series 1, the bridge deck slab was tested in its "as-cast" condition without any visible cracking; in Series 2, after the deck slab had been deliberately cracked transversely in the region of the center support; and in Series 3, after the deck slab had been deliberately cracked longitudinally over the whole length of the deck between each girder location.

The continuity behavior of the bridge in these tests is summarized in Fig. 3. The experimentally determined points for the influence line of total moment at the center support are compared with the theoretical influence line calculated using the elastic theory and assuming constant stiffness over the entire length of the bridge.

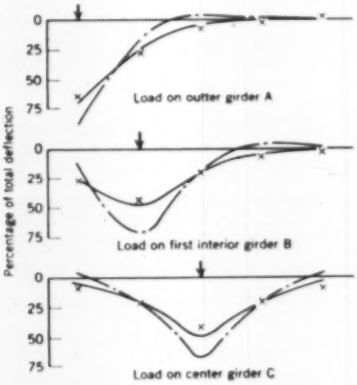
Each experimental point marked is the average of ten measurements, which were found to be grouped closely around the average value. The experimental points are in reasonably good agreement with the theoretical line. The reduction in stiffness of the structure in the region of the center support, due to the transverse cracking in that area, is clearly reflected in the reduction of the average percentage continuity from 92.3 in Series 1 to 86.8 in Series 2. The longitudinal cracking of the slab between the Series 2 tests and the Series 3 tests apparently reduces the stiffness of the midspan regions of the bridge structure, since the average percentage continuity rose to 91.2 percent in the Series 3 tests.

The measured lateral distribution of deflections at midspan in the Series 1 tests is compared in Fig. 4 (*a*) with the distribution of deflections calculated using the Guyon-Massonet theory.[3,4] Each experimental point is the average of four measurements, which were found to be very closely grouped. The deflection of each girder is expressed as a percentage of the total deflection of the five girders. Three typical cases are considered—load on an outer girder,

load on a first interior girder, and load on a center girder. The dashed line represents the theoretical distribution of deflections if the torsional stiffness of the girders and the deck slab are neglected in the calculation. This would roughly correspond to an arrangement whereby the slab was connected to the girders by a pin joint along the top of each girder.



(a) The measured lateral distribution of deflections at midspan in the Series 1 tests are compared with the distribution of deflections calculated using the Guyon-Massonet theory.



(b) The Series 3 test results are compared with the calculated distributions of deflection in which the properties of the cracked section were used for the deck-slab stiffness.

FIG. 4. Experimental and theoretical deflections are compared.

The solid line represents the theoretical distribution of deflections when the torsional stiffness of the girders and the deck slab are taken into account. The flexural and torsional stiffnesses of the girders measured before construction of the bridge were used in these calculations, together with the calculated flexural and torsional stiffnesses of the deck slab, assuming an uncracked section. It can be seen that there is excellent agreement between the experimental points and the theoretical curves calculated, including the effect of torsion.

The distribution of deflections in the Series 2 tests, in which the deck slab was cracked only in the region of the center support, was found to be almost identical with the distribution of deflections in the Series 1 tests, although the absolute magnitude of the deflections had increased slightly because of the increased longitudinal flexibility.

In Fig. 4 (*b*) the Series 3 test results are compared with the calculated distributions of deflection in which the properties of the cracked section were used for the deck-slab stiffness. Once again the dashed line corresponds to neglect of the influence of torsion and the solid line to the inclusion of torsion in the calculations. The large reduction in stiffness of the deck slab leads to a more pronounced difference between the two calculated distributions than was the case for the Series 1 and 2 tests. Since the experimental points lie close to the solid line, it may be concluded that the torsional stiffness of the girders has a considerable beneficial effect on the transverse load distribution, when the deck-slab stiffness is reduced as a result of longitudinal cracking.

The measured deflections in the Series 3 tests lie approximately half way between the calculated distribution of deflections for Series 1 and that for Series 3, indicating that the use of the cracked-section properties in the calculation of the deck stiffness for Series 3 underestimates the effective stiffness of the deck slab. This is probably due to the fact that longitudinal cracks only existed over roughly half the total width of the deck slab, being concentrated in regions adjacent to the edges of the girders on the top face of the slab, and in the middle third of the center-to-center distance between the girders on the lower face of the slab.

Space does not permit an exposition of the Guyon-Massonet theory. It will be noted only that, for purposes of analysis, the bridge structure is replaced by a slab having equivalent flexural and torsional stiffnesses. Solution of the slab problem is facilitated by the availability of curves of deflection-distribution coefficients.[5] These are entered by the use of two parameters, one relating the longitudinal and transverse flexural stiffnesses of the structure, the other relating the torsional stiffness of the structure to the flexural stiffness of the structure.

Overload tests of bridge

The second phase of the tests of the bridge consisted of a series of overload tests, culminating in a test to destruction. In these tests the bridge was loaded by a group of four concentrated loads to simulate the distribution of loads in the extraordinary military bogey loading for which bridges on the interstate highway system must be designed. In all the tests extensive measurements were made of reactions, deflections and strains, using methods already described. In these tests the loads were applied by hydraulic rams, and measured by load cells at the bridge deck.

Although the equivalent military loading does not govern the design of this bridge, this disposition of loads was chosen so as to obtain information on the load distribution characteristics of the bridge at high concentrated overloads. If the bridge had been loaded with the H20-S16 loading in all lanes, the test would simply have reproduced on a larger scale the result already obtained in the test of the single continuous girder previously referred to.

The continuity behavior of the bridge was satisfactory up to a load

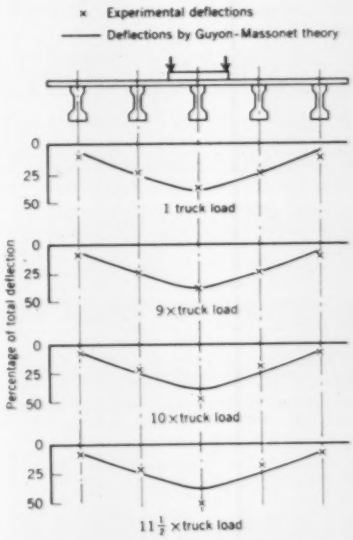


FIG. 5. Lateral distribution of deflections at four load stages in the final test are shown. Experimental points are compared with the distribution of deflections predicted by the Guyon-Massonet theory, including the influence of torsion.

equivalent to ten times the equivalent military truck load, at which load level a diagonal tension crack occurred in the deck slab around the loading heads. With further increase in load, the cracks spread and led to separation between the center girder and the deck slab. Redistribution of stresses resulting from this separation in turn led to failure of the center precast girder in the region of the loading heads when the deck slab punched through at a load equivalent to 11½ times the military truck load.

Lateral distribution of deflections at four load stages in the final test are shown in Fig. 5. The experimental points are again compared with the distribution of deflections predicted by the Guyon-Massonet theory, including the influence of torsion. Close agreement is obtained up to the time of the diagonal tension cracking of the deck, when, as is to be expected, the distribution characteristics of the bridge deteriorated.

These results are but a small proportion of those obtained. A very considerable body of data was recorded in the tests, and a substantial part is still in course of reduction and evaluation. It is already evident, however, that the use of conventional deformed reinforcing bars to produce continuity in precast-prestressed concrete bridges is a sound technique from the standpoint of structural efficiency.

Results obtained during the whole test program are being studied so that design criteria can be drawn up to cover the various aspects of the design of such a structure. This information will be published in a series of Portland Cement Association Development Department bulletins. The title of the series will be "Precast-Prestressed Concrete Bridges."

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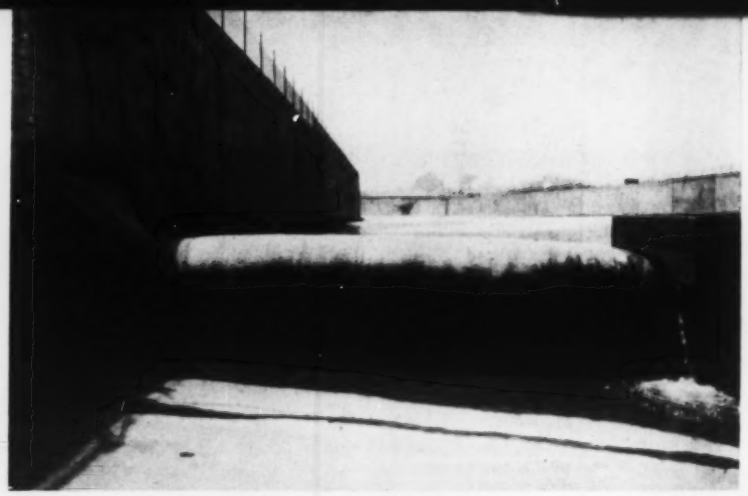
(This paper was originally presented by Messrs. Mattock and Kaar at the ASCE New Orleans Convention last spring, before the "Experimental Research" session of the Structural Division.)



Prototype dam was installed at one end of the wooden dam in 1957 to find out whether this type of collapsible structure would be feasible. Prototype was 20 ft long and operated at a height of 5 ft.

Collapsible dam

NORMAN M. IMBERTSON, Engineer in Charge,

Most dams are built to control floods and store water but Los Angeles has one that was designed to collapse at a predetermined water level in order to reduce flood hazards.

This unique dam—a giant nylon bag coated with neoprene and fabricated by the Firestone Tire and Rubber Company—was installed across the Los Angeles River by the Los Angeles Department of Water and Power. Designed by the writer, this bag is 150 ft long and 6 ft in diameter. It serves the requirements of the Department by backing up water in the river so as to replenish underground basins. It also meets the requirements of the U.S. Army Corps of Engineers and the County Flood Control District by being easily deflatable to pass flood flows.

For 45 years, the Department of Water and Power of the City of Los Angeles has maintained a 30-acre spreading ground along the south side of the Los Angeles River between the Walt Disney Studios and the Forest Lawn-Hollywood Cemetery.

Over the years water was diverted from the river by means of a wooden dam 5 ft high, which raised the level sufficiently for the water to flow through gates and on to the spreading grounds. Any surplus clear water coming down the river was diverted onto these spreading grounds to recharge the underground aquifer, from which it was later removed by pumping. This has provided an important source of water for a heavily populated area.

Whenever the silt content of the water was more than 40 to 50 parts per million (ppm), the spreading grounds would silt up and would require cleaning after an operating period of six or seven weeks. When the turbidity reached 400 or 500 ppm, the basins would become choked even sooner.

Since the cost of each cleaning of the 30-acre basin area was around $6,500, the normal method of operation was to bypass muddy waters. Also, because the Los Angeles River is a flood control channel, the old wooden diversion dam was designed to be washed out by any major flow. The net result was that the percentage of water reclaimed in the spreading basins was rather small as compared to what could have been salvaged if the basins could have been operated whenever surplus water was available in the river. That is, a much greater quantity of water could have been put on the spreading grounds if the silt could have been removed first.

For this reason, a product manufactured by the Dow Chemical Company was investigated. This product, called Separan 2610, is an organic polymer that has been used in the mining industry for ore processing. It causes colloidal materials to settle out of water with a turbidity as high as 1,000 or 2,000 ppm in a matter of minutes. In fact, one of its surprising properties is that the more colloidal material or fine silt there is in suspension, the fast-

Giant nylon bag coated with neoprene backs up the water in Los Angeles River to replenish underground basins. This structure is 150 ft long and 6 ft high. It takes about 25 min and 50,000 gal of water to inflate it. A period of only 10 min is required to collapse the dam automatically in case of flood conditions.

aids Los Angeles water supply

Water Plant Operating Division, Department of Water and Power, Los Angeles, Calif.

er the flocculent seems to settle it out.

The Department worked with the Dow Chemical Company to set up a pilot plant, which indicated that the product would do the work at a reasonable cost. Then, at the Company's recommendation, we picked a spot on the bank of the Los Angeles River 2½ miles above the diversion gates leading to the spreading grounds and erected a treatment plant with a capacity of 40 cfs. This location was chosen for the following reasons:

1. Here there was an access road leading down to the river bottom.

2. At this point there is what is known as a pilot channel in the bottom of the river. This channel, 10 ft wide and capable of carrying a maximum of 80 cfs of water, provides an ideal spot at which to add the Separan solution.

3. The distance of 2½ miles between this point and the wooden dam that formed the settling basin gave ample time for the Separan to mix with the river water.

After the plant was set up, a test run was made starting December 11, 1956, and continuing for 22 days. During the period of the test an average of 12.8 cfs of water was treated and placed on the spreading grounds—a total of 563 acre-ft. At the end of the 22-day period, the basin was drained and inspected. The test results indicated that:

1. The average spread water carried only 15 ppm of turbidity, ranging from as low as 7 up to as high as 20 ppm.

2. Practically no silt accumulated in the spreading basins.

3. The desilting operation was carried out at a total cost of $1.50 per acre-ft of water treated.

4. Since the Flood Control District estimates that the water spread is worth $15 per acre-ft, the net gain for the test was $7,300. Had this water been spread without treatment, the maintenance cleaning cost would have been about $6,500, which was saved by treating the river water in this way.

Since, with treatment, only algae problems would make it necessary to clean the basins, serious thought was given to developing a new method of cleaning. The result was a specially built scraper that removes the skin of algae together with not more than one inch of surface material. On the first try, this new machine cleaned the 30-acre spreading grounds for $1,300 instead of $6,500. Thus the machine, which cost $5,000, paid for itself on the first cleaning job.

The machine consists of a 5-cu yd carryall with paddle wheels just above the blade that push the algae or silt back into the body of the carryall. Ahead of this is a roller that maintains the carryall on an even keel. To make the use of this machine practical, it was necessary to grade the bottom of the basins and remove the large boulders.

Treatment of the water with Separan for about six months made it clear that there was no serious treatment problems. It also became clear that if we could have a diversion dam that could be kept in operation during the stormy season, even the muddy storm waters could be diverted into the channel leading to the spreading basins, some 2,700 ft downstream. By erecting another treatment plant between the diversion gates and the channel leading to the spreading basins, we could treat these waters in the channel, settle the silt in a separate settling basin, and then spread the water for groundwater replenishment.

Accordingly, it was decided that some money could be spent to design a diversion works that would not wash out in the winter. Plans and estimates were made to place a Tainter gate across the river. However, the Army Engineers objected to a gate of this type because it would require a center pier. This would tend to obstruct the full flow of the river, which at this point is in the neighborhood of 45,000 cfs. The estimated cost of the Tainter gate was in the neighborhood of $120,000.

The collapsible dam

One solution would obviously be a diversion dam of some material that would withstand the abrasion of water-borne rocks and sand and would collapse so flat that roots, floating trees, and general trash would pass over it in periods of flood. Then, when the flood has passed, it should be capable

of being raised again to normal height.

Rubber and synthetic rubber are such materials. Since they are flexible, they can be made to collapse, they withstand abrasion well (an automobile tire is an example), they can be reinforced with fabric to give them strength against tearing, and they are not excessively expensive. Since rubber tends to weather and check in sunlight and smog, neoprene, a synthetic rubber that weathers well, was selected. It was reinforced with nylon fabric for maximum strength and for weathering qualities.

A prototype automatic dam was constructed at one end of the wooden dam in the latter part of 1957. The prototype was 20 ft long, was operated at a height of 5 ft, and was fastened to the reinforced-concrete floor of the river channel at the upstream edge with steel anchor bolts set in the concrete. One end was fastened to a bulkhead at the end of the wooden dam and the other end was fastened to the concrete wall of the channel.

Various methods of attaching the ends were tried, and the principle of automatic collapse was perfected. Because of the many severe storms in the winter of 1957-1958, the strength and abrasion resistance of the materials were given a thorough test as well as methods of installation and operation.

The full-size dam was then designed as a large tube or bag, tear-drop in section, stretched across the river bottom and anchored to the bottom at the upstream edge with stainless steel bolts set into the concrete floor of the channel. See Fig. 1. The ends of the tube were extended up the vertical walls of the channel and these also were anchored with bolts. The tube, fabricated by the Firestone Tire and Rubber Company, is 30 ft in circumference and 150 ft long. As the river channel is 130 ft wide, the tube extends up each wall a distance of 10 ft.

The neoprene and nylon fabric is ⅛ in. thick. A strip of the material one inch wide will support over 500 lb without breaking. The tube is inflated with water from a pipe connection through the channel wall. It takes about 25 min and 50,000 gal of water to inflate it to its maximum height of 6 ft.

A period of only 10 min is required to collapse the dam automatically in case of flood conditions in the channel. A siphon was installed in the spreading-basin channel and connected through an 18-in. pipe to the water inside the dam. Thus, the pressure of the water in the dam is transmitted to the water in the pipe, which terminates in a simple siphon of a regulated height such that if the pressure inside the dam rises to a predetermined point, the siphon primes and deflates the dam. The dam can be inflated to any desired height up to approximately six feet, depending on the adjusted height of the siphon, which is designed to rotate 90 deg.

In other words, when a storm causes the river level to rise, the excess water flows over the top of the dam. The weight of this water on the top of the dam increases the pressure on the water inside the dam. When this pressure gets high enough, the water in the dam charges the siphon and the dam starts to deflate. This action continues until the dam is completely collapsed.

When completely deflated in a storm, the fabric lies flat on the bottom of the river channel and up the side walls, and all debris is carried over it by the water. When the storm waters subside, the dam is reinflated with water from a tank on the bank of the river.

The Separan treatment plant as constructed between the diversion dam and the spreading basins makes it possible to treat storm waters winter and summer, except for a period of perhaps a day or so when the rubber dam is deflated because of storm conditions.

The prototype dam has been reconstructed as a diversion dam in the spreading grounds. There it permits the diversion of water to either the upper or the lower basins so that at low flows one group of basins can be cleaned while the other group is in operation.

Since completion of the large dam about a year ago, there have been hundreds of inquiries about it. Foremost among them are questions as to the feasibility of this type of dam, called a Fabridam, for:

1. Temporarily raising the spillway lip of a dam, thus permitting the storage of two, three, or four extra feet of water in the reservoir. The collapsible feature of the Fabridam would guarantee the original spillway capacity of the main dam should it be required.
2. Diversion in irrigation works to replace flashboards, sluice gates, etc.
3. Provision of 1 to 10 ft of additional head, replacing stoplogs, etc., on ogee or overflow-type dams in hydroelectric plants, projects across rivers, etc.
4. Diversion of runoff flows from streams for the irrigation of adjacent ranches.
5. Levee construction. A collapsible dam used to put flood waters where they would do the least damage might well save a city or cities below the point of diversion.
6. Preventing ocean tides from running up a river and at the same time intercepting and perhaps putting to good use the fresh water coming down the river.
7. Creation of lakes, fish ponds, etc., for resort and other purposes.
8. Replacement of bascule and Tainter-gate installations in certain instances.
9. Skimming processes, as in pulp handling.

This dam is being patented by the author and fabricated by the Firestone Tire & Rubber Company. Additional information can be obtained from this company in the Coated Fabrics Division, 2525 Firestone Boulevard, Los Angeles 54, Calif.

(This article was originally presented by Mr. Imbertson as a paper at the ASCE Reno Convention, before the "Conservation of Water" session of the Irrigation and Drainage Division.)

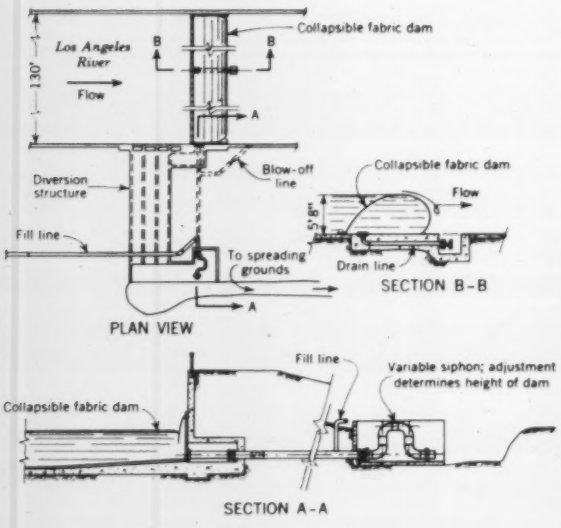


FIG. 1. Collapsible dam is inflated with water from a pipe connection through the channel wall. Under flood conditions, the water pressure inside the dam rises to a predetermined height, the siphon primes and deflates the dam.

Concrete pavement of warm-up apron is being spread and finished, utilizing Blaw-Knox 34 E paver and spreader, Jaeger finisher and Koehring float machines, with Iranian workmen, at Mehrabad International Airport.

Two international civil airports

UNDER CONSTRUCTION BY U.S. ARMY'S CORPS OF ENGINEERS

LEWIS W. McBRIDE, F. ASCE, Chief, U.S. Army Engineer Division, Mediterranean

WILLIAM O. TATUM III, Civil Engineer, U.S. Army Engineer Division, Mediterranean

Contracts for the rehabilitation and modernization of two international civil airports were awarded in July 1959 and February 1960 by the U.S. Army Engineers. Awarding contracts for airport construction is normally a routine event with the Corps of Engineers. These awards, however, are particularly significant since the U.S. Army Engineers now enter the overseas civil aviation field for the first time. The Corps of Engineers has developed excellent capabilities in this field from one experience in the design and construction of military airfields in many parts of the world. These capabilities now being applied to civil airport construction make a noteworthy

A 100-ton roller with tractor compacts subgrade at Karachi International Civil Airport, Pakistan.

At Karachi International Civil Airport, Pakistani mechanics and other workmen erect a crusher plant.

On load-bearing section of runway, subgrade material is processed before placing of flexible pavement.

contribution in furthering the foreign economic aid program of the United States.

The U.S. Army Engineer Division, Mediterranean, the only Corps of Engineers Division operating wholly outside the continental United States and its territories and possessions, designed the runways for the international civil airports at Tehran, Iran and Karachi, Pakistan. It will supervise the construction work through its Gulf District in Iran and the Trans-East District in Pakistan. On completion of these jet-age facilities, Tehran and Karachi can assume their rightful places on the international and around-the-world air routes served by the largest jet aircraft.

Traffic analyses forecast that by 1963 more than two hundred landings and take-offs per week will be made by Boeing 707's and Douglas DC-8's at Karachi International, with approximately a quarter of that number being handled at Mehrabad International Airport in Tehran. Neither field now has any runways capable of accommodating these aircraft at their planned 1963 operating weights—272,000 lb at Tehran and 288,000 lb at Karachi. When completed—approximately January 1, 1961 for Mehrabad and June 1, 1961 for Karachi—these airports will be physically equipped to handle any traffic likely to develop in the foreseeable future.

Mehrabad Civil Airport

Existing and new facilities at Mehrabad Airport are shown in Fig. 1. They consist of an east-west runway 9,843 ft long by 197 ft wide, a north-south runway 5,940 ft by 148 ft, approximately 60,000 sq yd of loading apron, and taxiways connecting the east-west runway and the north end of the north-south runway with the apron. All existing pavements are of portland-cement concrete, with thicknesses varying from 5 to 9 in., and were constructed in increments between 1940 and 1957.

Tests on beams sawed from these pavements gave flexural strengths ranging from a low of 210 psi to a high of 695 psi. The pavement constructed in 1940 is in very poor condition, with a great many slabs completely shattered. The pavement placed in 1953 is in fair to poor condition, while the 1956-1957 construction is in generally good condition.

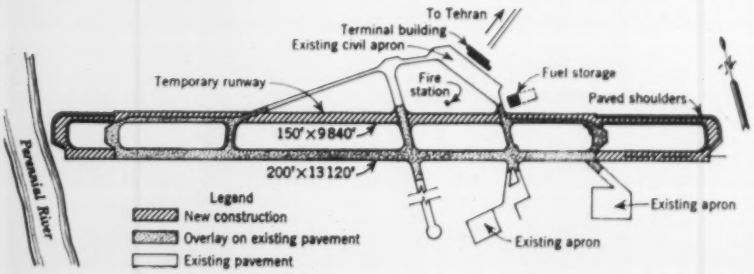
The subgrade is a non-plastic sandy gravel having an average natural density corresponding to 95 percent of the maximum density as determined by the modified AASHO Method T-99. The design CBR value for flexible pavements is 20 percent, and the design subgrade modulus, k, for rigid pavements, is 460 psi per in. The water table is approximately 115 ft below the ground surface.

Improvements to Mehrabad Airport will extend the east-west runway by 2,297 ft to the east and 984 ft to the west, giving a total length of 13,124 ft; provide an overlay on the existing 9,843 ft of the east-west runway, and provide new taxiways to connect the existing taxiway system to the ends of the extended runway. An overlay will be placed on the existing taxiways, and new bypass aprons near each end of the extended runway will be constructed.

A critical requirement is that the airport be kept in operation during construction. For all practical purposes this means that landings and takeoffs to the east and west must not be curtailed, as the east-west runway handles more than 90 percent of all traffic. By overlaying and widening two non-continuous 75-ft-wide taxiways to 150 ft, and constructing a 150-ft-wide connecting link, a temporary runway, 9,843 ft long located 728 ft north of and parallel to the existing east-west runway, will be available for use during the rehabilitation and expansion of the main runway.

All overlay pavements and new construction, with the exception of the two bypass aprons and 500 ft at each end of the runway, will be flexible, consisting of a 1½-in. surface and binder courses of dense-graded hot

FIG. 1. Mehrabad International Airport at Tehran, in Iran, is planned for completion by U. S. Army Corps of Engineers next January. Like the new Karachi Airport, it will then be capable of handling any traffic likely to develop in the foreseeable future.



plant-mix asphaltic concrete over various thicknesses of base and subbase courses. Minimum base-course thickness for overlay pavements will be 4 in., but a 7-in. thickness will be used in the overlay of the oldest portion of the existing runway. All new flexible pavements, including the widening of existing taxiways to serve as a temporary runway, will consist of 1½-in. asphaltic-concrete surface and binder courses over a 6-in. base and an 8-in. subbase course.

The bypass areas and the 500-ft runway ends will consist of an 8-in. portland-cement-concrete slab having a 90-day flexural strength of 700 psi. No base course will be used under the concrete pavements. The top 6 in. of subgrade under all new rigid and flexible pavements will be compacted to 100 percent of the Modified AASHO maximum density.

A non-load-bearing blast pavement will be constructed along both edges of all 75-ft-wide taxiways and around the bypass aprons. This pavement will be 25 ft wide along the taxiways and 50 ft wide adjacent to the aprons, and will consist of 2 in. of asphaltic concrete on a 6-in. base course.

Because of the extreme perviousness of the sandy gravel, no underground storm drainage system or culverts will be required. Surface runoff will be directed by swales to a series of leaching wells spaced approximately 650 ft apart along the edges of runway and taxiway shoulders. This system is similar to that now in use. Average annual rainfall in Tehran is only 9.7 in.

Of interest in design is the presence of several *ghanats* which cross the east and west runway extensions. A *ghanat* is an unlined, underground, hand-dug aqueduct used for collecting and distributing water for irrigation and domestic consumption. The underground tunnels are connected to the ground surface at intervals by vertical shafts from 3 to 4 ft in diameter. There are about sixty such shafts, from 26 to 165 ft deep, located within the lateral clearance limits of the runway and taxiways. Filling these shafts would block the flow of water through the *ghanats* below, so a reinforced concrete slab will be constructed over each shaft where required. The slab will be placed a minimum of 30 in. below finished grade.

Karachi Civil Airport

Existing facilities at Karachi consist of an east-west runway 7,550 ft long by 150 ft wide, approximately 220,000 sq yd of aprons, and various connecting taxiways. The original construction was done in 1939, and additional pavements were constructed in 1942 and 1944. All pavement, except for one taxiway, is of portland-cement concrete varying in thickness from 4 to 11 in. With the exception of a portion of the loading apron built in 1944 and the asphaltic concrete taxiway, all pavements are in poor condition. A portion of the runway had been previously overlaid with 2 in. of asphaltic concrete. The flexural strength of beams sawed from the best appearing part of the apron ranged from 600 to 800 psi.

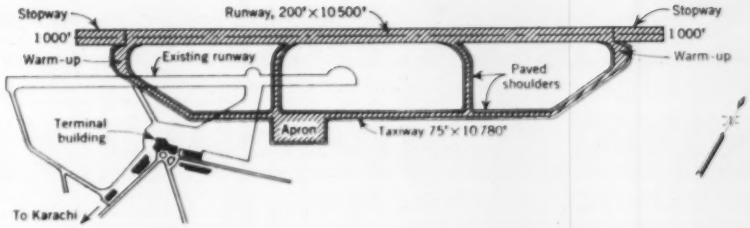


FIG. 2. Airport at Karachi, Pakistan, being built by the U. S. Army Corps of Engineers, is expected to handle more than two hundred landings and take-offs a week by Boeing 707's and Douglas DC-8's by 1963.

The subgrade is made up of a sandy silt and a silty sand with an average natural density corresponding to from 75 to 80 percent of the theoretical maximum density. The design CBR value is 1 percent and the design subgrade modulus is 125 psi per in. The water table is more than 15 ft below the ground surface, even during the monsoon season.

A complete new runway and taxiway system will be built. See Fig. 2. The new runway, 10,500 ft long by 150 ft wide, with a 1,000 ft surfaced stopway at each end, will be located 1,000 ft north of and parallel to the existing runway. A new taxiway 75 ft wide will connect each end of the new runway with the existing loading apron and with a new apron, 525 ft by 1,045 ft, to be constructed adjacent to the existing apron. Bypass aprons will be located near each end of the new runway. Two high-speed exit taxiways are located at about the third points of the runway, and connect the runway with the parallel taxiway. All pavements will be portland cement concrete. Aprons, taxiways and the 500 ft of runway at each end will be 13 in. thick, while the central 9,500 ft of runway will be 12 in. thick. A 4-in. base course will be used under all pavements.

All taxiways and aprons will have flexible, non-load-bearing blast pavements adjacent to them, consisting of 2 in. of asphaltic concrete over 6 in. of base. A load-bearing blast pavement 25 ft wide, consisting of 2 in. of asphaltic concrete, 6 in. of base and 28 in. of subbase, will be provided along each side of the runway and across the full width of the first 150 ft of each stopway. This pavement is designed to support a DC-8 at its maximum landing weight. It will take occasional traffic of this aircraft at its maximum takeoff weight.

Modern lighting systems

Both airports—Mehrabad and Karachi—will have modern high-intensity lighting systems. The system for Mehrabad was designed by a private engineering firm under contract with the Government of Iran, while the Corps of Engineers designed the Karachi system. A feature of the Karachi design is the use of flush center-line lights on all taxiways.

Both Mehrabad and Karachi pavements are designed structurally for the maximum gross weights of the Boeing 707-320 and the Douglas DC-8. Selection of pavement types was based primarily on first costs, with due consideration being given to future maintenance, availability of materials and time required for construction. Structural design was in accordance with Corps of Engineers criteria and methods, while geometric design, clearances, etc., conform to International Civil Aviation Organization standards and recommended practices.

All design for both projects, with the exception of the lighting at Mehrabad, was accomplished by the staff of the U.S. Army Engineer Division, Mediterranean, with headquarters in Leghorn, Italy. Construction contractor for the Mehrabad International Airport is the joint venture of Morrison-Knudsen Company, Inc., Henry J. Kaiser Construction Co., Oman Construction Co., Inc., R. P. Farnsworth & Co., Inc., and Wright Contracting Company, (M-K-O), under a $3,638,-851 contract. Vinnell Corporation of Alhambra, Calif., has the $4,369,256 contract for the work at Karachi International Airport.

The civil engineer's civic responsibility

JOHN E. WRIGHT, A.M. ASCE, Sales Engineer, Great Lakes Division, Armco Drainage & Metal Products, Inc., Indianapolis, Ind.

Let us first look in the dictionary in our endeavor to define the civic responsibilities of the civil engineer. Here civil engineer is defined as "an engineer whose training or occupation is in civil engineering, the designing and construction of public works, as roads, harbors, irrigation." It might have gone on to mention sewerage, water supply, and many other fields of civil engineering knowledge and practice.

As for the word "civic," we read, "relating to a citizen or a city . . . or civil affairs." For the purpose of this discussion the word "civic" will be used to include all levels of civic responsibility. These will be considered to be municipal, county, state, and federal.

A quotation from the article by Irving F. Ashforth, F. ASCE, on "Trends in Employment Conditions," in the March 1960 issue of CIVIL ENGINEERING, will serve to illustrate the degree to which the civil engineering profession is involved in work of a civic nature:

"Much of the art of civil engineering has been developed in specialties related to the functions of government—local, state and national—and approximately one-third of the membership of the Society [ASCE] is engaged in the field of public practice."

Roles in "civic service"

One can readily categorize civil engineers in their roles as administrators, designers, educators, and constructors into the following occupational fields:

Governmental—all levels, bureaus, departments, etc.
Private consulting firms
Universities
Private and public utilities
Contractors
Material and equipment (construction) manufacturers and suppliers

This group might be thought of as the construction industry's "Corps of Engineers."

The performance of civil engineers in "civic service" is viewed and the benefits are enjoyed in a perfunctory, taken-for-granted manner by the public, whom we have by definition named the chief beneficiaries of the products of the profession. It is only in recent years that the private citizen, jarred by the widespread application of federal aid, has become acquainted with the forces which plan, design and construct modern and adequate streets, highways, bridges, water works, sewers, buildings, dams, airports, subways, etc.

Those of us who are members of, or are in daily contact with the civil engineering profession and its activities know well the traditional role of the profession. The present age, however, is one in which many civil engineers are obliged to step out of their normal occupation of converting scientific knowledge into useful works and pursue certain other arts or professions—such as public relations, law, and even politics.

Irresponsibility and authority

The need for "politically oriented" civil engineers is attested to over and over in the daily newspapers of most communities. Some accounts of the progress of public construction are as amusing as "Lil Abner" and twice as fantastic. The antics of opposing political factions competing for by-lines and votes are equaled only by the unceasing efforts of their patronage loaded systems to "keep the rock *off* and the water *on*." The situation is clearly a case of irresponsible persons with authority and responsible persons (engineers) conspicuous by their absence from positions of authority.

New concepts in city planning, transportation and other fields are making the need for the influence of engineering minds in municipal and other government administrations clearer and more acute day by day.

No longer can city, county and state authorities look across the street at one another and say "you go your way and stay out of ours." The now trite expression "plan ahead" might well be expanded to "plan ahead *together*" in matters of public construction. The absence of such a doctrine in the past is testified to by countless monuments of poor construction planning—those works that were deserted almost before completion—subjects of premature death. The diagnosis, redundancy!

Civil engineers can do the job

What has all this to do with the civic duties of the civil engineer? Just this: more experienced and far-sighted civil engineers with administrative ability and the capacity to see local construction problems as part of a coordinated construction plan must shoulder their way into positions of responsibility and authority to see that the right kind of a job gets done in public construction. Such engineers must have, in addition to dedication to the code of their profession and mature engineering judgment, certain other capacities—a nonpartisan interest and understanding of politics at all levels, a knack for exercising diplomacy without compromising truth, experience in influencing others, and the ability to organize and plan effectively on a broad scale.

The time has come for engineers to crack their shells of superior knowledge and come out into the weather to assume positions of leadership and to face the risks that accompany great accomplishments.

The need for more engineering know-how in the higher echelons of public construction administration and planning is stated in the following quotation taken from the 1960 spring issue of the Engineers Joint Council newspaper, "EJC Engineer," under the heading of "National Affairs":

"Science and Engineering in the Government. The increasing role of government in engineering and scien-

tific activities, through financial support and actual programs, has repeatedly raised questions concerning the organizational framework under which the diverse activities are planned and administered. Because of problems of duplication, questionable emphasis and proliferation of programs, it has been proposed that a new Department of Science and Engineering be created to integrate and properly coordinate these activities. In invited testimony last year, EJC's President Augustus Kinzel and Past President E. R. Needles supported the establishment of a Commission—patterned along the lines of the Hoover Commission—to study and report on the entire complex problem of government's programming. Senator Humphrey's subsequent bill to form the Commission is not likely to progress very far this year but the matter will undoubtedly be reactivated next year. Its significance is becoming more apparent as the complexity of the nation's engineering and scientific effort increases and more outside pressures are made for particular projects or appropriations. Engineers will be called upon to participate more actively in the basic processes of policy decision making to offset increased pressures by social scientists and to balance the influence of scientists who speak only of 'scientific policy and effort,' exhibiting limited concern for engineering—the core of our technological progress. Even the political parties are availing themselves of advisory committees on 'science and technology' to lend credence to their views on the subject. A much more constructive contribution will surely be made by the engineering profession as the opportunity for service is given."

Changes in the curriculum

There has been much discussion of late in professional circles of major changes in the engineering curriculum and this discussion will doubtless continue. One faction would seek to produce a more socially oriented engineering graduate. Then there are the proponents of a more complete theoretical background who feel that the "humanities" can be acquired later by reading *Time* magazine during leisure hours. Perhaps the best way to decide such a question would be to examine it objectively by projecting the demands of the future on the profession, were this possible.

Students of engineering should be given an introductory course in political science, dwelling on local and state government functions. Such a course, though certainly not a substitute for first-hand experience in political situations, would serve as a valuable reference for beginning civils in fields of public and private construction. A bit more emphasis on contract and civil law in the engineering curriculum would also be a boon.

The engineer, as the exponent of applied scientific thought, when armed with the facts of life as they apply to politics and civil law, should be able to assume a definite position of leadership in the construction world of the "soaring sixties."

Responsibilities of the rank and file

So far, we have discussed what might be referred to as the "obligated destiny" of a minority group of civil engineers—those who possess the qualifications plus the stomach for the great responsibilities of public leadership plus the ambition to attain such positions. What about the rank and file of the profession? What are the common, everyday varieties of civic responsibility that fall to each of us as an engineer? Let's consider a few.

Public information service. Every civil engineer has opportunities in his job and in his community to inform the public of his profession's character and purpose.

Most people picture the engineer as sitting on a bulldozer or at a drafting board. Some think of engineers as walking almanacs of scientific and practical knowledge. Few see the engineer as the translator of scientific findings and facts into useful things and systems. It behooves each of us to clarify our profession's function in today's society.

Champions of community progress. Engineers have the right and the obligation as citizens of their communities to state their qualified opinions regarding the need for and the wisdom of current public construction programs. Projects under consideration and work in progress are open for the engineer's editorial comments based on educated opinion.

Why don't more engineers write letters to the editorial columns of the newspapers (which despite all their shortcomings are still the most effective medium of public education and influence) and also to public officials? To have an opinion without expressing it effectively is to have no opinion at all. Engineers must take care not to smother their effectiveness in conservatism.

Insurers of the profession's future. Every civil engineer has an unwritten obligation to his profession to encourage young men who are intellectually qualified and otherwise suited for the profession to pursue an engineering education. Grants, scholarships, and other stimulants aimed at getting good men into civil engineering should be supported actively and enthusiastically.

On and on continues the list of civic responsibilities which civil engineers carry because of the interdependent relationship between their performance and civic existence itself.

The potential contribution of the civil engineering profession is limited only by the imagination of its members and their willingness to put their full capacities to work for the good of society.

(This paper by Mr. Wright won the Daniel V. Terrell Award at the annual meeting of the ASCE District 9 Council in Columbus, Ohio, in April 1960.)

EJC Supports Nominations to Hall of Fame

Engineers Joint Council has passed resolutions supporting the nominations of Sylvanus Thayer and Thomas A. Edison in the quinquennial election being conducted for the Hall of Fame for Great Americans at New York University. The resolutions, which point out the homage due the two men by the engineering profession, were passed by the EJC Board of Directors April 22.

Thayer has been nominated for the Hall of Fame category of "Educator." Edison's name has been submitted for the category of "Inventor." The Council resolution supporting Thayer pointed out his strong influence in establishing engineering education in the United States while he served as Superintendent of the United States Military Academy from 1817 to 1833. Edison was praised for making possible the growth of the engineering profession through his inventions of electrical, electronic, and communications devices.

Established in 1900 as a gift to the American people, the Hall of Fame is administered by New York University. Individuals chosen for the shrine must have been dead at least 25 years. They are designated by categories according to their careers. Only one person has been elected in the category of "Engineers and Architects." He is James Buchanan Eads (1820-1887), a civil and marine engineer and member of ASCE, chosen in 1920.

ASCE NEWS

Victory in ASCE Drive

The news about the Society's campaign for funds for the United Engineering Center couldn't be better. On August 17 ASCE reached its $800,000 quota, becoming the first of the original Founder Societies and the second of the major engineering groups to raise its apportioned share in the campaign for member funds. Sometime ago the American Institute of Chemical Engineers went over the top in its drive for $300,000. The Electrical Engineers have achieved 94 percent of their $900,000 quota; the Mechanical Engineers 88 percent of their $800,000 share; and the Mining Engineers 82 percent of their $500,000 quota.

It is said to have been an additional contribution from Honorary Member George W. Burpee that pushed ASCE over the top in the Member Gifts Drive. In the closing days of the campaign seven more Local Sections achieved Honor Roll status by completing their campaigns. In all 45 Sections have met their quotas. Ten other Sections have less than $1,000 to go. The Los Angeles Section, which got off to a slow start, made a triumphant recovery and finished 45th on the Honor Roll. The Kentucky Section finished first (long ago), and the Southern Idaho Section did best percentagewise (201 percent).

Though the total number of contributors (around 14,600) is somewhat less than a third of the membership of the Society, ASCE ranks second among the major engineering societies in the percentage of individual subscription. Oddly enough, and happily, over 80 percent of ASCE contributions have been in cash. The official statistics on the ASCE drive will be reported in the October issue.

Thanks to many

ASCE will long have cause to be grateful to its members who have made it possible for it to have a share in the beautiful and functional new Center. Fund-raising personnel—from the chairman of the Member Gifts Campaign Committee, ASCE Past President R. E. Dougherty, to the Section officers who have sparked the campaign at local level—have given unstintingly of their time and effort to bring the Society's part in the fund-raising drive to a triumphant close.

The four most recent Presidents of the Society—Mason Lockwood, Louis R. Howson, Francis S. Friel, and Frank A. Marston—gave first priority to the Center during their terms of office. ASCE Past President Daniel V. Terrell was an indefatigable worker in the cause of a new Center years ago—before a site had been chosen or concrete plans had been made.

The list of those to whom thanks are due is almost endless. However, very special thanks go to two Executive Secretaries of ASCE—William N. Carey and William H. Wisely. As Executive Secretary from 1945 to 1955, Mr. Carey was one of the first to recognize the need for a new Center and to help institute feasibility and site studies. As Executive Secretary since 1955, Mr. Wisely has played a dominant role in activating plans for the Center and in directing the Society's successful campaign.

Executive Secretary William H. Wisely has played a leading part in directing the Society's fund-raising campaign for the United Engineering Center.

Steel topped out

While ASCE has been in the throes of closing its campaign, the new Center is rising on United Nations Plaza, with work nearly a month ahead of schedule. Topping out for the Center took place late in July, just three months after the first piece of steel was placed. Groundbreaking ceremonies, last October 1, were headed by former President Herbert Hoover, Honorary Member of the Society and another pioneer in recognizing the need for the Center as a symbol of the growing strength and unity of the profession and as a very practical means for helping the societies achieve their professional goals.

Plans for the Center have been almost a decade in the making. The site on United Nations Plaza, between 47th and 48th Streets, was acquired in 1957 after intensive study of proposed sites in Pittsburgh, Washington, Chicago, Philadelphia and other cities. Since then United Engineering Trustees, which will own and administer the Center for the participating engineering societies, has been supervising design and construction of the building and the fund-raising campaign.

By mid-1961 the staffs of some fifteen engineering societies expect to be working in the new Center. This fine headquarters—an eighteen-story tower of glass, metal, and limestone, rising from a two-story base—will provide some 180,000 sq ft of office space, almost twice the room available in the present headquarters building.

Besides additional office space and facilities for the Engineering Societies Library and the Engineering Index, the Center will provide expanded and improved facilities for meetings and conferences. A large meeting room on the first floor, which will accommodate about 430, will have the latest in audio and visual equipment. This room can be divided for smaller meetings. Another space, with seating capacity for 135, can be divided into two, three, or four rooms as the occasion demands.

One of the important features of the new Center is an exhibit space of 6,000 sq ft on the first floor for displays that will set forth the story of engineering for the benefit of the public. Planning for the use of this exhibit will be under a committee headed by R. Karl Honaman, a Fellow of the AIEE.

Shreve, Lamb and Harmon Associates are the architects for the Center. The structural engineers are Seelye, Stevenson, Value & Knecht, and the mechanical and electrical engineers are Jaros, Baum & Bolles. The contractor is the Turner Construction Company.

UEC will be sixth home for ASCE

When ASCE moves into the new Center, it will be occupying its sixth headquarters. Its first home consisted of some rooms in the Chamber of Com-

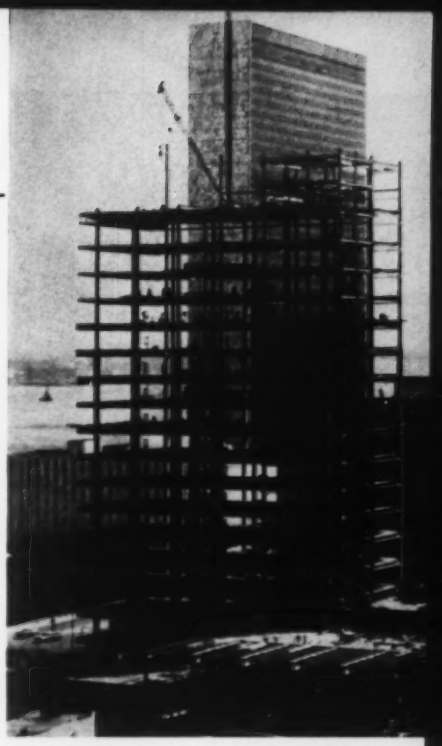
for UEC Funds

merce on William Street in downtown New York, where the first Annual Meeting was held on November 6, 1867. In May 1877 the Society moved to a rented house at 104 East 20th Street, and in May 1881 it purchased a dwelling at 127 East 23rd Street for its staff offices, Reading Room, and meeting rooms. (Incidentally, it was in one of these ASCE meeting rooms that the American Institute of Electrical Engineers was formally organized in 1884.) In 1897 ASCE moved into the building it still owns on West 57th Street.

The Society remained on 57th Street until 1918 when it joined the other Founder Societies in the present Engineering Societies Building on West 39th Street, where it occupies the two top floors that were especially built by it. The move to the present Headquarters Building—Andrew Carnegie's generous gift to the engineering profession—was made largely in the interest of professional cooperation, so that the headquarters building could be considered truly representative of the Founder Societies and the engineering profession.

As is well known to members, the present Engineering Societies Building has housed the staffs of the Founder Societies and the Engineering Societies Library since the early years of the century. An impressive structure in its day, it is no longer comfortable or adequate for the staffs of the societies that cooperated in its building. In addition to being obsolescent, the present headquarters now houses several times the number of employees it was originally designed to accommodate.

The move next year to the United Engineering Center, a bold new symbol of the engineering profession, may well be one of the most important steps taken by ASCE in its second century of development.



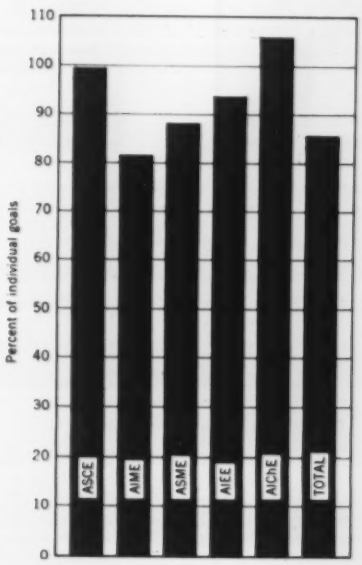
As breeze catches the American flag, a high column for the United Engineering Center is set into place and the steel structure for the building is completed. The brief topping-out ceremony, late in July, was attended by city officials and by representatives of the societies that will occupy the building. The U.N. Building looms in the immediate background.

UEC HONOR ROLL

As ASCE goes over the top in its drive for funds for the United Engineering Center, there are 45 Sections that have reached Honor Roll status. Newcomers to the list are Buffalo, Montana, Cleveland, Massachusetts, Wyoming, Louisiana, and Los Angeles. Once again we give prominence to the praiseworthy group of Sections, listed here in the order of meeting their quotas.

Kentucky (123)
Lehigh Valley (137)
Nashville (103)
Cincinnati (143)
Columbia (137)
Philadelphia (153)
Hawaii (130)
Rochester (125)
Ithaca (145)
Southern Idaho (201)
Indiana (140)
Delaware (111)
Kansas City (119)
Central Pennsylvania (109)
Arizona (111)
West Virginia (142)
Central Ohio (108)
Tri-City (118)
Puerto Rico (115)
Wisconsin (106)
Georgia (110)
Maryland (109)
Tennessee Valley (110)
Metropolitan (119)
Connecticut (110)
Maine (104)
Rhode Island (103)
Alaska (109)
Central Illinois (109)
Syracuse (110)
Illinois (103)
Nebraska (107)
Iowa (106)
Duluth (104)
Virginia (101)
San Francisco (101)
Spokane (101)
Texas (101)
Buffalo (102)
Montana (101)
Cleveland (101)
Massachusetts (103)
Wyoming (102)
Louisiana (101)
Los Angeles (102)

ASCE goes over the top in the drive for member funds, the second of the major engineering societies to enjoy this distinction.



Recently restored steeple of Boston's "Old North Church" towers above the statue of Paul Revere. It was here, on April 18, 1775, that the famous patriot hung his signal lanterns to warn of the march of the British troops to Concord and Lexington. The original steeple, felled by hurricane "Carol" in 1954, was rebuilt by popular susbcription the following year. The church is one of many historical landmarks to be seen.

Research and Professional Matters on Boston Convention Program

A research conference and three sessions on professional matters will supplement the well-rounded technical program being prepared for the ASCE Annual Convention to be held in Boston, October 10-14. The Massachusetts Section will be host to the Convention, and the Statler-Hilton Hotel will be Convention headquarters.

During the 39 technical sessions, running from Monday morning through Friday afternoon, a total of 146 technical papers will be presented. In addition, there will be three panel discussion programs. The Engineering Mechanics Division has the largest number of meetings scheduled, a total of eight, at which 31 papers will be presented. The same number of technical papers will also be presented at four Structural Division sessions. In addition to two conventional technical sessions, the Structural Division will have two special sessions devoted to brief reports on important developments in current research projects. Informal discussion of the projects will be encouraged. Nine other ASCE Technical Divisions are also sponsoring sessions. The full Boston Convention program appeared in the August issue.

Boston Convention Committee is seen in one of the numerous planning sessions that must precede all successful meetings. In front row, left to right, are Mrs. Charles H. Norris, member of Ladies Entertainment Committee; Prof. Charles H. Norris, president of the host (Massachusetts) Section; General Convention Chairman William H. Mitchell; and Mrs. Arthur T. Ippen, chairman of the Ladies Entertainment Committee. Standing, in same order, are John H. Hession, chairman, Budget and Finance Committee; Paul S. Crandall, chairman, Field Trips Committee; Emory Ireland, chairman, Technical Program Committee; Cranston R. Rogers, chairman, Hotel Committee; Roger Williams, chairman, Luncheon Committee; John L. Lowe, chairman, Student Committee; F. T. Sendker, chairman, Registration Committee; and Bruce Campbell, chairman, Public Relations and Exhibits Committee.

The Research Conference, planned and conducted by the Research Committee of ASCE, will feature three aspects of the subject: "Research for Survival," by Lt. Gen. Arthur G. Trudea, Chief of Research and Development, Department of the U.S. Army; "Research and Civil Engineering Education," by Dr. Nathan M. Newmark, of the University of Illinois; and "Research and Professional Societies," by Dr. Arthur T. Ippen, of the Massachusetts Institute of Technology. Wednesday afternoon will be devoted to this timely program.

Conditions of Practice sessions

Engineering education is also the subject of one of the sessions of the ASCE Department of Conditions of Practice, at which a report on the Conference on Civil Engineering Education —held recently at the University of Michigan—will be presented. The second professional session of the COP Department will be a panel discussion devoted to the participation of publicly employed engineers in professional society activities. A third COP session will discuss employment conditions, and include an examination of civil engineers' compensations and environmental conditions in outstanding engineering offices. The Conditions of Practice sessions have been carefully scheduled so as not to interfere with any technical meetings.

The engineer's contribution to human kind will be emphasized in the daily luncheon programs. At the Welcome Luncheon on Monday William F. Keesler, senior vice president of the First National Bank of Boston, will discuss "The Contribution of the Civil Engineering Profession to Urban Redevelopment." The topic at the General Membership Luncheon on Tuesday will be "The Contribution Which the Civil Engineering Profession Can Make to World Development and Understanding," presented by Rear Admiral E. J. Peltier, Navy Chief of Civil Engineers. At the Awards Luncheon on Wednesday Dr. James R. Killian, Jr., chairman of the Massachusetts Institute of Technology Corporation and former Special Assistant to the President for Science and

Technology, will speak on "The Role and Responsibilities of the Engineer and Scientist in Modern Society." Another highlight of the Wednesday luncheon will be the conferring of Honorary Membership in the Society on four distinguished engineers.

In the traditional Wednesday morning ceremonies prizes and awards for the past year will be presented, and new ASCE officers will be installed. The 1961 President of the Society will then deliver his inaugural address. Prof. Glenn W. Holcomb, of Oregon State College, is the official nominee for this post.

The crowded social program will get off to a good start with an "Icebreaker Party" late Monday afternoon. Engineers who have paid the registration fee and their ladies will be guests of the Massachusetts Section at this cocktail party. Monday evening the Boston Society of Civil Engineers is holding a dinner, at which the Hon. John J. Collins, mayor of Boston, will be the speaker. The annual dinner of the American Institute of Consulting Engineers is scheduled for Tuesday night. A special feature of the Society's annual dinner dance on Wednesday evening will be the award of the John Fritz Medal to Stephen D. Bechtel, F. ASCE.

Indicative of Student Chapter interest in the Convention are the exhibits of some twelve New England universities that will be on display at the Statler-Hilton during the Convention. A special Student Day program is planned for Wednesday morning, after which the students will join members for the Awards Luncheon and the afternooon research program.

The Convention will take place against a backdrop of equipment and materials provided by the annual Civil Engineering Show. The exhibit, which is being held for the fourth time, will give members a chance to observe at first hand the latest developments available to the civil engineer.

Known as the "City of Yesterday and Tomorrow," Boston is one of the nation's few old cities to retain its colonial charm. Yet with all its quaintness, it is a highly modern city boasting the latest in highways, in parking facilties, in transportation, in modern airports, and in housing. Possibly most interesting of all to Convention visitors will be the great research laboratories in nearby Cambridge said to house one of the world's greatest concentrations of scientific brainpower. Several of these famous laboratories are on the program of Convention tours.

ASCE Executive Committee Meets in Cleveland

The Executive Committee of ASCE met in Cleveland, Ohio, on August 5 to take action on matters referred to it by the Board of Direction or matters requiring action before the Board meets at Boston in October. President Marston was in the chair. Also present were Past Presidents Howson and Friel, Vice Presidents Elsener, Holland, Knapp and Molineaux, and Executive Secretary Wisely.

ECPD-EJC merger

Action was taken on a previous proposal to **merge Engineers Council for Professional Development** and **Engineers Joint Council.** The original proposal for a merger had been deferred by ECPD, pending the outcome of its application for exemption from federal income taxes. Since ECPD has now been granted this exemption, it is felt that there should be no further obstacle to effecting the proposed merger. Thus the Executive Committee voted:

1. To urge all three ASCE representatives to ECPD to attend the organization's annual meeting at Montreal, October 3-4, and to authorize the President to name alternates for any representatives who cannot attend.

2. To request ECPD to include the merger question on the agenda of its Montreal meeting.

3. To instruct the ASCE representatives to ECPD to make every effort to see that the proposal for merger is referred to the member societies of ECPD for official ballot as soon as possible.

Joint committees

The American Institute of Consulting Engineers has assumed leadership in reviving the informal **Joint Task Committee** with ASCE, EJC, the Consulting Engineers Council, the American Road Builders Association, and the National Society of Professional Engineers. The aim of the committee is concerted, constructive action in the controversy that has arisen over the use of private engineering consultants in connection with the Federal Highway Program and other government operations. ASCE was represented by President Marston and Executive Secretary Wisely at a recent meeting in Washington, at which it was decided to continue the Joint Task Committee as a medium for maintaining friendly and cooperative relationships between public engineering bureaus and private engineering firms.

The committee appointed Mason Lockwood and Gustave J. Requardt as ASCE representatives to the Joint Task Committee, with Enoch R. Needles as an alternate.

The **American Institute of Consulting Engineers** and the **Consulting Engineers Council** have each approved a proposal to establish a joint committee with ASCE for the purpose of centralizing policy and action regarding the private practice of engineering. To prevent delay in setting up the joint committee the ASCE Executive Committee designated Louis R. Howson and Craig P. Hazelet as ASCE representatives to it. The other two organizations are also appointing representatives to the joint committee.

UEC fund raising

The Executive Committee discussed the status of **ASCE in the UEC fund-raising campaign.** With ASCE then within $10,000 of meeting its quota [now it's been met], the Executive Secretary was directed to send a telegram to all Local Sections that had not yet met their quotas urging them to make a final effort during the month of August so that the $800,000 member-gift quota could be reached in time for announcement in the 1960 Annual Report of the Society.

Engineering Foundation grant

The **Engineering Foundation** has offered ASCE $10,000 to be matched by the Society for the purpose of establishing a Research Department in ASCE during the year ending September 30, 1961. The Committee on Division Activities has recommended that the offer be accepted and urged the Executive Committee to make a favorable recommendation to the Committee on Budget.

The Executive Committee voted to recommend to the Board of Direction that the grant be accepted and to direct the Budget Committee to provide the required matching funds in the 1960-1961 budget.

Appointment to ASEIB

The Executive Committee voted to reappoint Richard Hazen to a three-year term as ASCE representative on the **American Sanitary Engineering Intersociety Board.** Mr. Hazen's second term will end September 30, 1963.

Death Takes Honorary Member André Coyne

André Coyne, Honorary Member of the Society and head of the French consulting firm of A. Coyne & J. Bellier, died recently in Paris at the age of 69. An Honorary Member of ASCE since 1952, Mr. Coyne was one of the very few foreign engineers to achieve such distinction. Famed as a designer and builder of dams, he was also noted for his achievements in the fields of port and maritime structures.

While serving with the great French engineers Caquot and Freyssinet as civil engineer for the Port of Brest in the 1920's, he perfected a new and ingenious device for retaining structures (wall facings anchored to the base itself by means of ties). During this period he also made the first tests on ausculation of structures by means of vibrating chords, and supervised construction of the large Plougastel Bridge designed by Freyssinet. A specialist in arch dam construction, he devised many innovations in the field, including the ski-jump spillway, used for the first time in l'Aigle Dam, one of the tallest in the Alps. His other notable achievements included the arch cofferdam at Saint-Etienne-Cantales, which has the unusual feature that its length is equal to five times its height. In all he built over fifty dams, including several high arches in Portugal and North Africa.

Mr. Coyne was appointed head of the French Technical Service for Large Dams in 1935, and Inspector General of Bridges and Roads in 1943. For a number of years he was president of the French National Committee and of the International Commission on Large Dams, presiding over the international meetings held in Stockholm in 1948 and in New Delhi in 1951.

Conditions of Practice Committee Meets in Cleveland

Several matters of general Society interest were discussed at a meeting of the Committee on Conditions of Practice, held in Cleveland on August 6. One was a recommendation from the Committee on Professional Practice that Local Sections for next year be advised that nominations to vacancies on this Committee may be made from the membership at large without regard to whether the individual is in consulting practice, private practice, university work, or otherwise engaged. There had been some feeling that membership on the committee should be limited to engineers in consulting practice, and the Committee on Engineers in Public Practice had recommended that the matter be clarified.

There was extensive discussion of the value of non-competitive sessions for the COP programs at ASCE Conventions. Such sessions could result in eliminating as many as 12 technical sessions, and in consequence, there has been some complaint from the Technical Divisions. It was agreed that the COP programs must be maintained at a high level and feature top speakers. It was the consensus that when programs of top quality cannot be arranged for a Convention, the COP Committee should not attempt to sponsor a program. It was further agreed that the theme and general topic of COP programs should be reviewed by the Committee on Conditions of Practice.

There was also considerable discussion of the pros and cons of unionism as applied to ASCE. This committee recommended to the Committee for Younger Members that a proposed session on the subject at the Phoenix Convention be a panel discussion on "The Incompatibility of Professionalism with Unionism."

John Fritz Medal Goes to ASCE Member

Stephen D. Bechtel, F. ASCE, president of Bechtel Corporation, San Francisco, has been selected as the 1961 recipient of the John Fritz Medal, which is awarded annually for notable scientific or industrial achievement in the engineering profession. One of the highest honors bestowed by the engineering profession, the award was established in 1902 by friends of the late John Fritz, Hon. M. ASCE, to perpetuate the memory of his achievements in industrial progress. It is sponsored by the five Founder Societies.

The citation granting the award to Mr. Bechtel reads: "Engineer, builder, industrialist and leader of broad vision in large construction undertakings, nationally and internationally—a pioneer in the creation and development of the modern construction industry, which is unequaled throughout the world and which has made possible the pre-eminence of our country in time of war and in time of peace."

Mr. Bechtel has been associated with the company which bears his name for 42 years. Under his direction the firm has grown into one of the world's top-ranking engineering and construction organizations. Currently it is responsible for projects all over the world.

Long active in public service pursuits, Mr. Bechtel has served as member and chairman of the Business Advisory Council of the U. S. Department of Commerce; as trustee of the Committee for Economic Development; as one of President Eisenhower's five-man Advisory Committee on a National Highway Program; and as consultant to the National Security Council.

Mr. Bechtel will receive his award, a gold medal and an engraved certificate, at the dinner meeting during the Society's Boston Convention next October.

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

City	Current	Previous
Atlanta	1.21	1.38
Baltimore	1.14	1.14
Boston	1.23	1.22
Chicago	1.49	1.45
Denver	1.25	1.24
Houston	1.26	1.26
Kansas City	1.15	1.13
Los Angeles	1.32	1.28
Miami	1.38	1.57
New Orleans	1.22	1.18
New York	1.29	1.25
Pittsburgh	1.07	1.07
Portland (Ore.)	1.24	1.27
San Francisco	1.34	1.30
Seattle	1.06	1.06

Highway Departments

Region	Current	Previous
I. New England	1.03	1.01
II. Mid Atlantic	1.15	1.14
III. Mid West	1.29	1.27
IV. South	1.13	1.12
V. West	1.16	1.06
VI. Far West	1.17	1.17

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current total of base entrance salaries for ASCE Grades I, II and III by an arbitrary base. The base used is $15,930, the total of salaries paid in 1956 for Federal Grades GS5, GS7 and GS9. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was July 30, 1960.

Staff Reorganized for Improved Member Service

The constantly enlarging scope of Society interests and activities involves new staff responsibilities and provides new opportunities for staff service in the field of member activities. Coincident with the ASCE Board of Direction appointment of Don P. Reynolds as Assistant Secretary of the Society, Executive Secretary William H. Wisely reassigned areas of staff contacts for closer coordination of Society efforts.

Mr. Reynolds will continue to have responsibility for the technical development of the Society. His assignment includes assistance to the Society's 14 Technical Divisions and their many committees, the groups that accomplish the major work of the Society, as well as help in generating programs for conventions and conferences. These programs provide many of the papers published in the Journals and CIVIL ENGINEERING. Mr. Reynolds is also in charge of coordinating standards activities and of stimulating research in the Society.

Don King, who rejoined the staff in January 1959 as Assistant to the Secretary, is responsible for coordinating and managing the Society's professional activities in the Department of Conditions of Practice. These activities include education, registration, salaries, employment conditions and professional conduct.

E. Stuart Kirkpatrick has been assigned to new responsibilities as Executive Assistant to the Secretary. In this capacity Mr. Kirkpatrick will aid the Executive Secretary in his multiple duties and will carry out various specific assignments in all areas of Society activity.

Otis Gouty, Assistant to the Secretary since 1957, will take over the work of coordinating the ASCE Conventions formerly handled by Mr. Kirkpatrick. Mr. Gouty is also in charge of the Society's work for the Local Sections.

John H. Fisk, who recently joined the staff as an Assistant to the Secretary, has responsibility for coordinating Student Chapter activities. He will work with Mr. Gouty in the conduct of other field services and convention operation.

It is believed that this reassignment of duties will strengthen the work of the Society's administrative staff in all aspects of service to the membership.

Engineering and Science Lead in Russian Education

The route to the top in Russia is through engineering, members of the Engineers Joint Council mission to Russia (CIVIL ENGINEERING, August 1960, page 112) said on their return. The team, which spent a month in the Soviet Union, consisted of Walter E. Lobo, consulting chemical engineer of New York; H. Russell Beatty, president of Wentworth Institute, Boston; Carlton S. Dargusch, Columbus, Ohio, adviser to the Engineering Manpower Commission; Oleg Hoeffding, economist, the Rand Corporation, Santa Monica, Calif.; Sydney B. Ingram, director of technical employment, the Bell Telephone Laboratories, Inc., Murray Hill, N. J.; and Robert M. Mahoney, manager of industrial relations development, the Union Carbide Corporation, New York.

The objective of the mission was basically to study the utilization of engineers and engineering technicians and their interrelationship in the Soviet Union. The group was taken to thirteen technical institutes, three technicums, and five industrial plants.

About 20 percent of the high school students are permitted to continue higher education immediately. The others must spend two years in practical work and industry before they can continue their education. Many of these become well-trained technicians, who are effectively used to support the work of engineers. Even the 20 percent admitted directly spend sixteen months in practical work in industry, graduating after about 5½ years.

Some 50 percent of the higher education in Russia is in engineering and the sciences. About 70 percent of the top management in engineering and engineering education institutions appeared to be Communist Party members. All the visiting group were impressed by the broad program of continuing education through evening and correspondence courses, with up-grading and refresher courses that provide opportunities for large numbers of men and women at all levels to continue their technical education. At one institution it was noted that among civil engineer graduates this year there were three women to one man. Women engineers do not reach top positions in Russia. The motivation to train women as engineers is apparently one of need rather than belief in equal opportunity.

It was noted by the group that engineering students are given basic instruction programs and highly specialized training within the educational institutions. In contrast, students in the United States generally receive their specialized training in industry. However, Russian engineers may start as technicians or even workers.

Contrary to some earlier reports it seems that there is a considerable degree of freedom of job choice within an engineer's specialty. The system appears to work well within the Soviet Union's planned economy. Within Russia there is a drive to learn and full recognition of the value of engineering and technological training. There is a challenge that must be considered if we are to maintain our position in the world, the visitors to Russia concluded.

(More ASCE News on page 75)

In intermediate stage of construction, stiff-leg derrick on a timber runway is unloading steel from Audubon Avenue.

Erection of structural steel has been completed for three floors. A fourth floor was decided upon later.

STIFF-LEG DERRICK SOLVES MUD PROBLEM

MORGAN I. DOYNE, M. ASCE, Engineer, Ben Hur Construction Company, St. Louis, Mo.

Utilizing a structural-steel frame, high-strength bolts and galvanized centering to support concrete floors, parking space for 571 cars is being provided in St. Louis at a construction cost of $1,208 per car. This structure is the first to be built under a revised St. Louis building code that permits garage structures open on all sides to rise to a height of 40 ft. The garage is located at the Washington University Medical Center near Forest Park, site of the 1904 World's Fair.

The building site (Fig. 1) is in a highly congested traffic area and is bordered on the north and east by streets, on the west by a hospital drive, and on the south by a railroad cut. Since none of these could be used for construction equipment, the only space available to the steel erection subcontractor for erection equipment and storage of materials was the basement area of the building itself. Late March snows had turned this basement into a morass in which the tops of many anchor bolts were under water.

To avoid the inefficiency of walking a crawler crane back and forth through the mud to unload and erect the steel frame (it was impossible to drive trucks into the basement area), a modified 10-ton American Hoist and Derrick Co. stiff-leg derrick was used. This derrick, with a 120-ft boom, was trucked to the site and assembled in the basement with a 14-ton Koehring crawler crane. The derrick was assembled on wooden rollers, which ran on heavy wood planking. The original position of the derrick was between column lines 4 and 5 near the center of the structure (Fig. 1). The first steel was unloaded from trucks at the east end of the structure and subsequent loads from Audubon Avenue on the north side.

The framework of structural steel utilized field-welded moment connections, high-strength bolts and machine bolts. The three parking decks, one of which is the roof, are reinforced concrete over galvanized corrugated centering. The basement, also utilized for parking, is a concrete slab at grade. The perimeter columns are continuous for three floors with provisions for an additional floor (Fig. 2). The interior columns are each one story high, bolted to the girders above and below by high-strength bolts of 1-in. diameter. The wide-flange girders, 24 in. deep, were shipped in sections having a maximum length of 63 ft, and were welded in the field at the perimeter columns and at two intermediate splice points (Fig. 1) to form continuous members 158 ft long. The 14 WF 30 floor beams for the top deck and the 12 WF 27's below are about 19 ft long and support 24-gage corrugated Granco Tufcor steel centering. This spans nearly 9 ft and was temporarily supported at midspan during concreting. The deck is 4½ in. thick and is reinforced with No. 3, ⅜-in.-diameter bars in each direction. Alternate bars are raised at the beams to take negative forces.

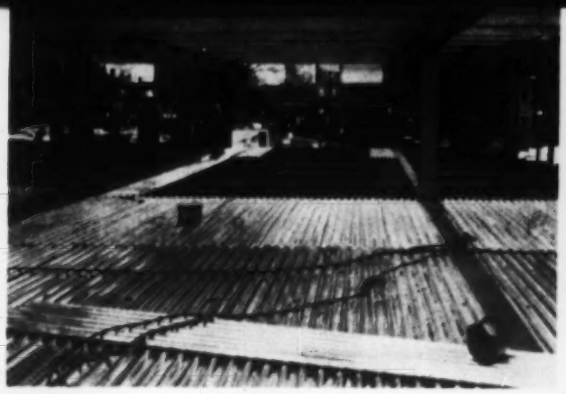
Steel for three column lines was erected from each derrick location. Work proceeded from south to north for the full three-story height along each numbered column line before erection of the steel to the west. When the structure had been erected to the third column line, the derrick was rolled along under its own power to the next position (Fig. 1). When the derrick reached the fifth and final position against the west wall, all steel except that blocked by the derrick itself was erected. Then a 25-ton Link Belt truck crane, operating from the hospital access drive, disassembled the derrick and loaded it on trucks. This truck crane completed the steel erection.

The 715 tons of structural steel were erected in 18 days of actual derrick and crane time. During the course of construction the job as a whole was expedited by coordinating the delivery of centering and of reinforcing rods with the delivery and erection of the structural steel. The long reach of the stiff-leg derrick made it possible to land these materials at convenient points on the structure, thus speeding up subsequent operations.

To avoid delays in later operations, the floor beams were "loose bolted" immediately behind the raising gang. After each derrick move, the three previously erected column lines were plumbed by means of cables and turnbuckles, the columns having been set to grade on steel shims adjusted to proper elevation with an engineer's level. The machine bolts then were tightened with Black and Decker electric impact wrenches powered from electrical outlets on the Hobart welding machines, which were gasoline-engine powered. Immediately after the structure was plumbed, and concurrent with tightening of the machine bolts, the field welding was done.

Since the steel centering was planned and delivered in three-bay increments, it was laid in place and welded as soon as the structural welding was complete in each area. The placing of reinforcing steel and pouring of concrete then proceeded without delay.

The high-strength bolts, of 1-in. di-



The 24-gage galvanized corrugated steel centering was tack welded in position.

In structural framing for St. Louis parking garage, note connection angles for floor beams attached to girders.

ON ST. LOUIS PARKING STRUCTURE

ameter, were tightened by the turn-of-the-nut method. After the centering in a specific area had been placed and welded—thus providing a convenient working deck—two-man teams torqued the nuts of the high-strength bolts in the upper flanges of the girders at that particular level, before placing of the concrete. While one man used a crescent wrench to prevent rotation of the bolt head, the other man, using an open-end wrench with a 5-ft handle extension, torqued the nuts. By this method, the nuts were turned three-quarters to one full turn past the "hand-tight" position. A spot check with a dial-indicator hand-torque wrench resulted in readings well above the recommended minimum values. The high-strength bolts in the lower flange of the girders were torqued in a similar manner, except that the man handling the wrench worked from the concrete deck below, and his assistant worked from a pipe scaffold rolling on the concrete slab.

Shortly before the erection of structural steel for the first three floors was completed, the decision was made to add a fourth floor. After the third-floor slab has been placed, a small stiff-leg derrick will travel over the deck erecting the steel in two passes.

The parking structure was designed by the architectural firm of Russell, Mullgardt, Schwarz, and Van Hoefen, with Neal J. Campbell as consulting engineer. The general contractor was the Alport Construction Co., with the Stupp Bros. Bridge and Iron Co. supplying structural steel and centering. The structural steel and centering were erected by the Ben Hur Construction Co. of St. Louis, Springfield, and Indianapolis.

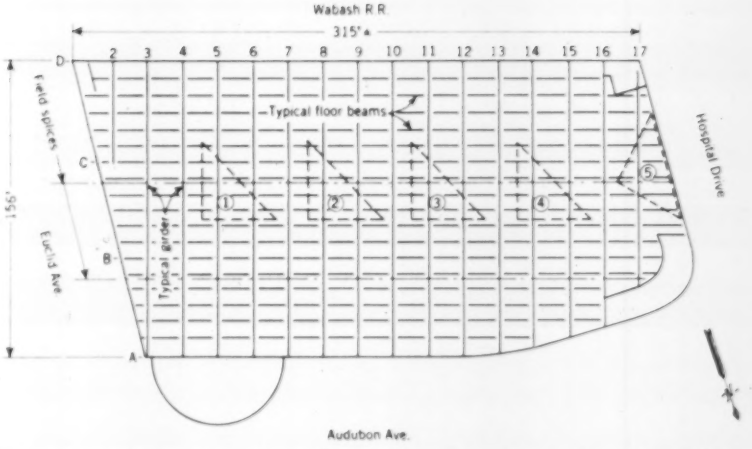
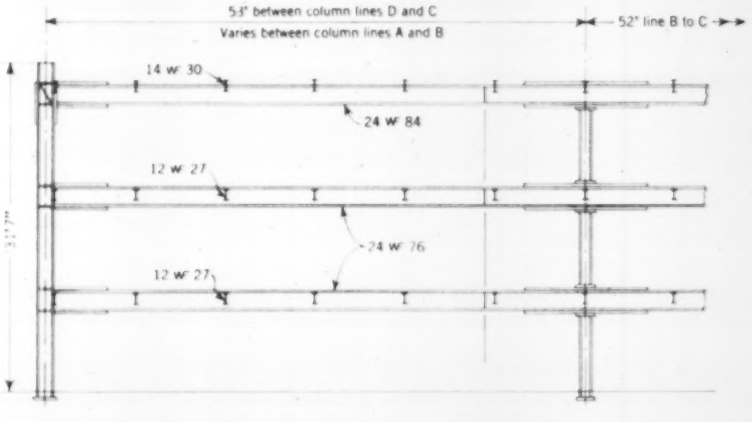
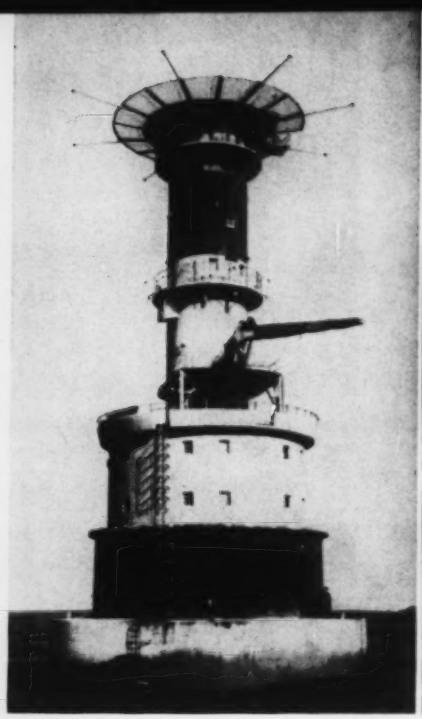


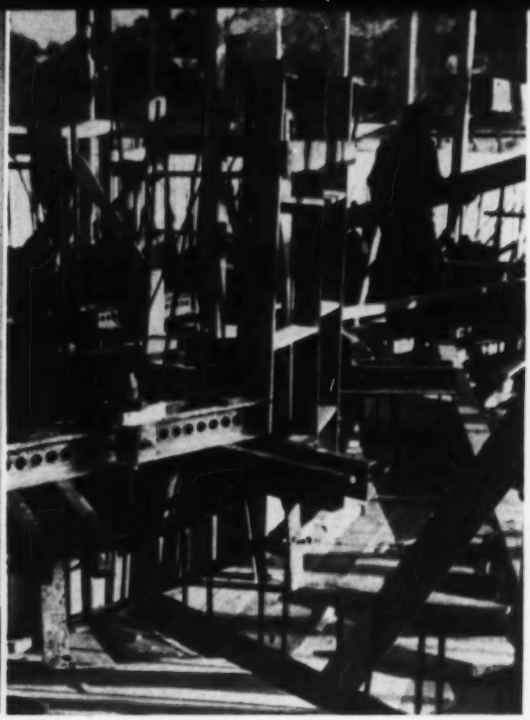
FIG. 1. Plan of St. Louis parking garage, showing successive positions of the derrick used for erection.

FIG. 2. Typical cross section through parking garage. A fourth deck is to be added.





Near right: Sweden's Grundkallen Lighthouse was constructed near shore, in the form of concentric caissons, to about the level of the crane. After the unit was positioned at the site, one caisson was lifted by pumping in water.



Far right: A total of 84 "Concretor" slipform jacks were operated from one hydraulic pump to raise the forms for the concentric caisson units.

Telescopic caisson for a lighthouse base

ROBERT V. GELLERSTAD, Civil Engineer
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Swedish National Board of Shipping and Navigation
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The challenge of building in the sea on a shallow reef has been met in a new way in the construction of lighthouses in Swedish waters. An advanced method—the telescopic caisson, largely prefabricated in a protected area—has been successfully used for lighthouse construction at three locations. The method is adaptable to other uses in shallow water at sea.

The telescopic caisson method is very simple. It consists of building two or more caissons, nested one inside another—called a "caisson set." After the unit has been moved to the prepared site at the shoal and sunk by ballasting, the inner caissons, that is, the telescopic caissons, are raised by pumping water into them. They are fixed in the raised position by connecting them to the foundation caisson and to one another.

This permits almost all the construction to be carried on adjacent to the shore. Also, the permanent equipment, such as power plant and air compressors, can be installed and used for the sinking of the caisson set on the shoal and for the remaining work at sea. The method saves a great part of the expensive and risky construction time at sea. The need for highly skilled lighthouse builders working at sea is very much reduced, compared with other building methods.

The first lighthouse built by this method was the Grundkallen Lighthouse in the South Bothnian Sea, replacing a lightship of the same name. Distance to the nearest coast or protecting reef varies from 8 to 170 nautical miles. The boats used for the work were berthed 14 miles from the site and the distance to the nearest harbor was 33 miles.

The caisson set consisted of two caissons (Fig. 1). The outer caisson, the supporting caisson, had an outside diameter of 18.2 m (59.7 ft). It had an internal circular shaft, the telescopic shaft, with a diameter of 13 m (42.7 ft) and a height of 14 m (45 ft). The intermediate space around the shaft was divided into six buoyancy pockets. Inside the telescopic shaft nested the telescopic caisson containing rooms for power plant, heating plant, oil storage, etc., and the living quarters for the crew. It had four stories, a diameter of 12 m (39.4 ft) and a height of 12.2 m (40 ft).

Six rooms on each floor, each measuring 12 sq m (129 sq ft), were grouped around a central circular staircase. The two lower floors are used mainly for machinery and stores and the two upper floors for living quarters. A tower rising an additional 21.3 m (70 ft) is placed on the telescopic caisson. One and a half stories of the

Construction was continued through the winter. The framework supported an enclosure to protect the concrete.

Reinforcement is set for the bottom slab and the fixed double walls of the caisson. The circular form became the slip form for the caisson. The pipes are for grouting under the caisson.

tower also were built on land but the upper part of the tower was constructed, and equipment installed, at the site.

The shoal had been sounded and investigated in 1956. It consisted of hard granite rock. Three places were found where the bottom was fairly even. The rock could be leveled for the lighthouse caisson by blasting and filling with gravel to a depth of 7 m (23 ft).

The intention in 1956 was to build the Grundkallen Lighthouse in the usual manner, that is, to set a foundation caisson and erect the tower on it.

The telescopic caisson method was invented by the writer in June 1957. Design and project drawings were immediately prepared by the Lighthouse Building Department according to the new method. Vattenbyggnadsbyran (VBB), Stockholm, the consulting engineers, were then in charge of the stability design as well as the structural design of the lighthouse and the pile base on which it was to be built.

Stability against flotation

The lighthouse had to be designed with adequate stability against flotation. For telescopic caissons, this often has a decisive influence on the dimensions. In the structural design, consideration had to be given to each of the different stages—load distribution on the pile base, water pressure during launching and towing, wave pressure and shock load on the shoal, and the like. As most of the walls and the slabs of the caissons had to be thin to provide sufficient metacentric height, the structural design had to be carried out in great detail.

Model tests were performed by Prof. E. Reinius at the hydraulic laboratory of Chalmers Institute of Technology, Göteborg, to investigate the stability against wave forces for different locations on the shoal. Previously a theoretical investigation had been made by VBB to ascertain the size of the highest waves that could reach the shoal with regard to fetch and duration of storms. The hurricane of January 2 and 3, 1954, with a wind velocity of more than 30 meters per sec (67 mph) for 24 hours, was calculated to give a significant wave height of about 11 m (36 ft). For those waves that were considered to exert the greatest forces on the lighthouse, the total horizontal force on the lighthouse model was measured, as well as the overturning moment.

Two locations on the shoal were investigated for different directions of the waves. If the lighthouse were placed some distance from the edge of the shoal, the greatest waves would be broken so that they would have lost much of their energy when they

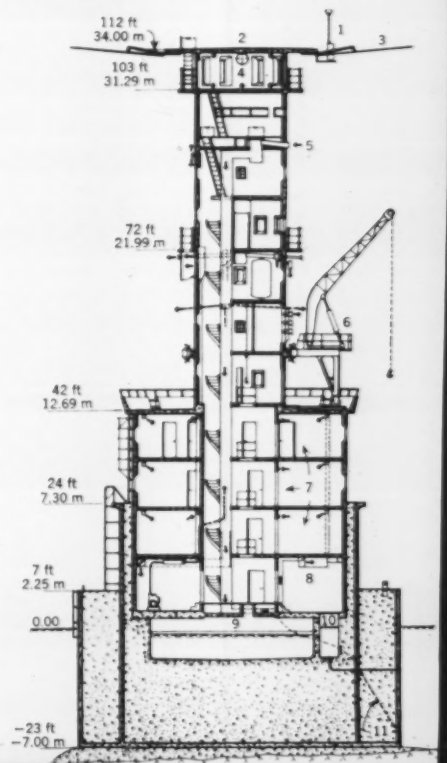


FIG. 1. Sectional elevation of Grundkallen Lighthouse. Outer caisson with the two circular walls and movable inner caisson were completed near shore to the fifth story. Arrows show air flow. Numbers show: (1) radar aerial (retractable), (2) helicopter landing platform, (3) radio beacon aerial, (4) light beacon room, (5) fresh-air intake from three directions, (6) derrick, which can be moved around the tower, (7) living quarters, (8) machinery rooms, (9) fresh-water tank, (10) salt-water intake and tide gage, (11) lightning conductor.

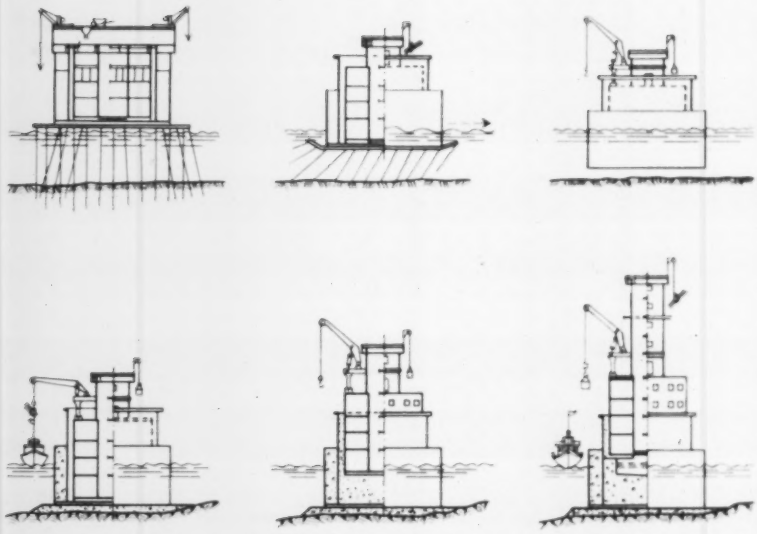


Fig. 2. Caisson sets for the Grundkallen Lighthouse were built near shore on a pile-supported platform. The inclined piles on one side were removed and jacks used to push the platform over, thus launching the 59-ft-high unit. The caisson was sunk on a prepared base and the inner units lifted by pumping water into them. They were then permanently held in place by intruding grout into prepacked stone.

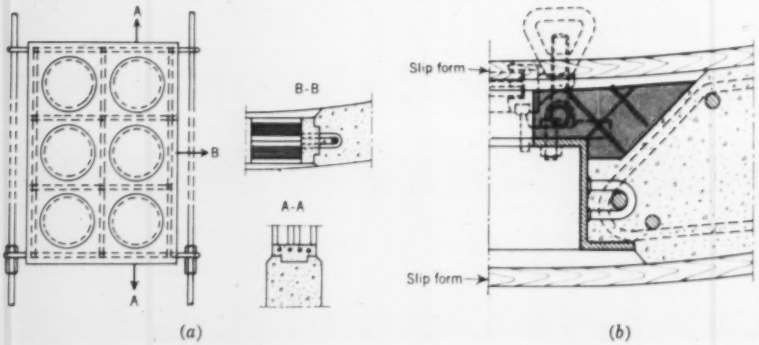
reached the structure. Thus the greatest waves out at sea were not the most dangerous. The tests were filmed and from the film strip the wave profile was obtained in different phases so that a theoretical calculation of wave pressure, uplift and their moments could be carried out. The directly measured values and those calculated by this method showed a good agreement.

Construction of the caisson set was begun late in 1957. Since a dock or a slip was not available for the work, the caisson set was built on a pile base in a small harbor near Stockholm. A schematic idea of the design and the procedure of building, launching, siting and erecting the lighthouse is given in Fig. 2.

Some details of this work may be mentioned. (See Fig. 3.) All circular and radial walls were cast by use of the "Concretor" hydraulic slip-form equipment. The length of these walls was 196 m (643 ft) and the wall area was 2000 sq m (21,530 sq ft). A total of 413 cu m (540 cu yd) of concrete was used. Some 1000 recesses had to be left in the concrete for subsequent joints, pipes and electrical wiring. During the casting, the outside temperature dropped to −10 deg C (+14 deg F) and sometimes snow fell. The slip-form was left on top of the walls to be used as a platform for the remaining work.

During May an exact examination of the site was carried out by the writer with the help of divers. Drift ice was present, and many anxious seals looked at us from large ice floes. The location for the lighthouse was definitely fixed. Leveling of the ground was begun on June 1 by blasting away the higher part of the rock and filling the lower part with stone. The area for the foundation caisson, with a diameter of 20 m (66 ft) was then leveled at a depth of 7 m (23 ft) by filling with gravel. To obtain a good horizontal surface, two divers laid out radial steel rails from a central point with the aid of a carpenter's level.

FIG. 3. Left: Glass block and concrete window-frame are held in slip-formed wall by vertical rods. Right: Frame for opening is held by rod through U-bolt. Shaded area is wood filler.



Launching and setting

On June 7, 1958, the caisson set was launched. This was done by blasting away the inclined piles on the seaward side and by applying a horizontal force between the quayside and the piled base by means of a jack. Some of the piles had required a slight inclination against the quay and therefore the force was increased up to 140 metric tons (154 short tons) before the pile-supported base collapsed and the caisson set was afloat. It was towed 110 nautical miles to a place near the lighthouse site.

The final work at the site was done during the night of July 11-12, when, in good weather, the caisson set was placed over the leveled bed by means of winches with cables to four anchors. It was lowered by flooding the bouyancy pockets in the outer caisson. Subsequently these pockets were filled with gravel, which was injected with cement grout by the Intrusion-Prepact method. When the pockets were only half filled with gravel, a storm came up, blowing with a velocity of 20 meters per sec (45 mph) from the most open direction, which the caisson set readily withstood.

On the morning of August 22 the set was ready for the raising of the telescopic caisson. Water was pumped in between the caissons. The inner caisson rose steadily at a rate of 1.5 m (5 ft) per hour. After a rise of 7.3 m (24 ft), the top had attained a height of 18 m (59 ft) above sea level. The floating caisson was leveled exactly and held provisionally. The caissons were then permanently connected in the space by filling between them with vertical concrete strips at the six radial walls of the inner caisson.

The inner part of the outer caisson and the remaining space between the caissons were filled with gravel. Forms for the fresh-water tank were built and the salt-water and sewage pipes installed underneath the inner caisson. Lightning conductors were also connected. The balcony 13 m (42.7 ft) above sea level was finished after a

violent gale had blown away the first falsework and forms. Construction was stopped in the later part of November. The lighthouse was operated provisionally during the winter of 1958-1959 with a small crew living in it.

Work began again at the end of May 1959 with the injection of cement grout under the inner caisson and in the space between the caissons. The upper part of the tower was cast by means of a slip form to its full height of 34 m (111.5 ft) above sea level. Floors, balconies and the helicopter landing platform were cast and other building work was finished. The internal work was completed and the remaining equipment, such as the AGA aids to navigation, installed.

The beacon was put into regular service on December 13, 1959, after only 18 months of effective working time ashore and at sea. See Table I. The Grundkallen lightship station, established in 1864, could now be withdrawn. A breakdown of construction time is given in Table I.

Costs summarized

The cost of investigations, designing, model tests, construction, inclusive heating and ventilating plant, heat exchangers, pumps, oil tanks, sanitary installations, electric lighting, cooking facilities, refrigerators, furniture and fittings came to Swedish kroner 1,750,000. The power plant and equipment for the beacon totaled 400,000, bringing the total to Swedish kroner 2,150,000, or about 400,000 U. S. dollars. To this cost should be added about 5 percent for overhead charges and boats belonging to the Swedish Board of Shipping and Navigation.

The first use of the telescopic caisson method gave very good results. Much work had to be done at the site at sea, especially on the upper part of the tower. The important advantages were so evident however, that the construction of two other telescopic caisson lighthouses was begun in January 1959, when the Grundkallen lighthouse was not yet completed. For these the tower was built to the full height, including the helicopter landing platform, as telescopic caissons. All equipment was installed and tested before launching. For these the diameter of the outer caisson is 22 m (72.3 ft) and the weight at launching—in July and September 1959—was 1,650 metric tons (1,850 short tons). These structures were located in May and June 1960 at a depth of 14 m (46 ft) and the telescopic tower will be raised 15 m (49.3 ft). They are unmanned lighthouses of a different type from that of the Grundkallen.

The construction of a fourth telescopic caisson lighthouse was begun in January 1960. It will be of the same type as the Grundkallen, but complete from the bottom to the helicopter landing platform when launched. The diameter of the outer caisson is 23 m (75.5 ft) and the height of the caisson set, 31.5 m (103 ft). The weight of the caisson set, including equipment and furniture, will amount to about 2,500 metric tons (2,750 short tons). The structure will be located next year at a depth of 10 m (32.8 ft) in the open sea. The overall height after raising telescopically will be 43.5 m (142 ft).

TABLE I. Time spent on lighthouse construction

Step	Work	Year	Hours
1.	Building caisson set ready for towing to site	1958	32,000
2.	Leveling site by blasting and filling with gravel	1958	5,000
3.	Grouting gravel bed under caisson set and pockets of outer caisson	1958	7,000
	Grouting foundation caisson under the telescopic caisson	1959	4,000
4.	Other work at sea	1958	10,000
		1959	16,500
5.	Investigation, crew's time on boats, attendance at power plant, time waiting for suitable weather, etc.		26,500
	Total hours		101,000

Other types of construction

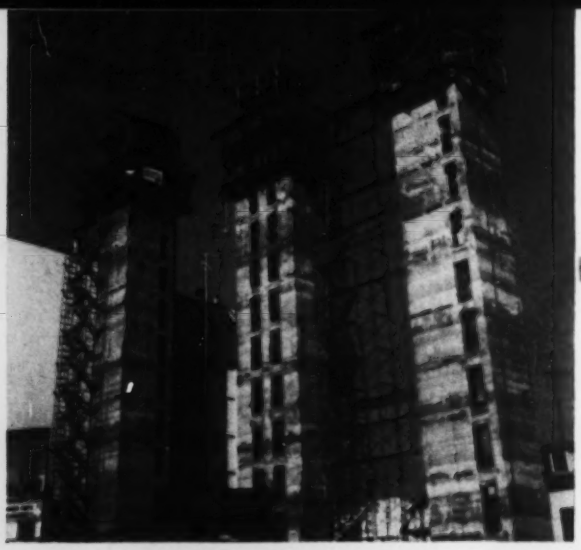
The telescopic caisson method, which is patented in several countries, is suitable for other types of construction, where the water depth, current, tide and wind conditions make building difficult and expensive. These might include breakwaters, bridge piers, weather and radar stations, water intake and discharge stations for power plants, shafts for access and ventilation, undersea tunnels, and mine shafts.

The telescopic caisson can be built on shore as a number of ready components with low height and therefore with good floating stability. It can be built to a suitable draft for the building site of the caisson set and for the ports and sea lanes to be traveled. The major part of the construction work can be done on shore, using normal machines. The permanent equipment for the lighthouse can be installed and tested on shore and some of it used during the construction period at the site.

The work to be done immediately after the caisson set has been landed at the site is mainly filling, which can be handled by ordinary mechanical equipment for placing gravel and sand and by using usual methods for making concrete, such as the Intrusion-Prepact method. The time required for construction work demanding good weather conditions at sea will be short. With the use of high-quality reinforced concrete, the construction will be economical and maintenance low.

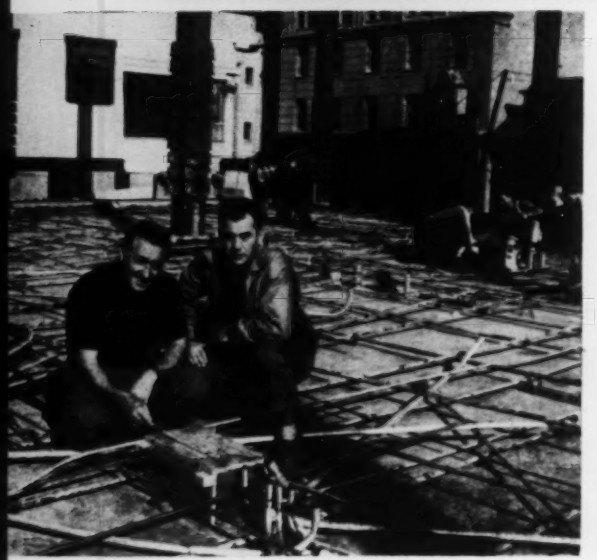
The caisson for Grundkallen Lighthouse was launched by a 154-ton push from jacks, which caused deflection and failure of the supporting timber piles.

Svindbaden Lighthouse, of a different type from Grundkallen, is here seen being launched. It was positioned at the site on May 13 and on June 30 the tower was raised telescopically 15 m (49.3 ft). This unmanned structure will be finished in September.

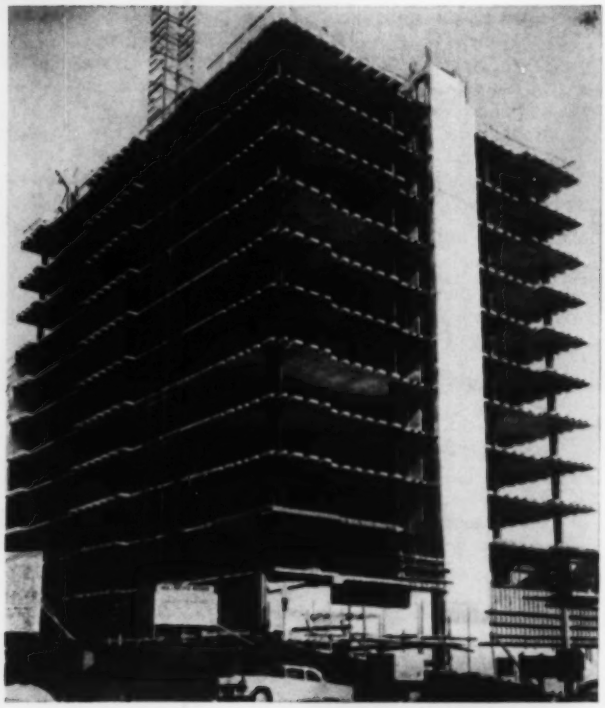


◀ The slip-formed towers for stair wells and elevators were erected before the rest of the structure, thus eliminating the need for temporary bracing.

Precast post-tensioned slabs were lifted from the basement for this 13-story apartment house in San Francisco.
▼



▲
Owner-contractor George P. Belcher and construction engineer Herbert Korner inspect imbedded material before casting of slab. Lifting collars were slipped over the columns before erection.



◀ First two slabs have been raised to top of first tier; next two are being raised. The rest of the slabs are still at basement level.

In slabs stacked at ▶ basement level, where they were cast, tendons have been stressed. Shim plates are in place between washers and plates.

A 13-STORY BUILDING BY LIFT SLAB AND SLIP FORM

HERBERT KORNER, Construction Engineer, Belcher Construction Company, San Francisco, Calif.

For a 73-unit, 13-story apartment building now being built in San Francisco, methods not usual in this type of construction are being employed. Towers to contain the stairs and elevators were slip-formed in concrete and the slabs post-tensioned and lifted on their own steel columns. The structure is believed to be one of the highest slip-form, post-tensioned, lift-slab buildings in the world.

Contractor George P. Belcher purchased a corner property, with 8,100 sq ft of usable space for the apartment house proper, in a congested residential area. There was a challenge to plan a structure that would provide the optimum rental space within the allowable building height of 105 ft above ground level. Coupled with this was the need to find a faster and more economical method of building.

Slip-formed towers

A preliminary analysis indicated that the stair and elevator towers could be designed to absorb seismic forces, thus eliminating the need for additional shear walls. To free the structure from temporary bracing during erection, an advantage was seen in having the towers erected before the rest of the structure. To put up the towers in the shortest possible time, slip-forming seemed the most suitable method. The three towers were individually stable and could be constructed separately without scaffolding or bracing. The pipe scaffolding seen in one of the photos is for access only.

Considering the limited space available for construction and storage, emphasis was placed on minimum form work and staging. Flat slabs cast at basement level and lifted to a height of 13 floors provided the answer to this problem. This method saved about 20 in. per floor on vertical depth and permitted the addition of two floors to the building within the permissible 105-ft height.

Loads in excess of 1,400,000 lb were to be supported on an orange-brown cemented sand with a bearing value of 12,000 psf. This layer was found 27 to 30 ft below grade.

The foundation consists of caissons 2½ to 5 ft in diameter, drilled with bucket or auger bits to the desired depth, and having bells opening up 15½ ft in diameter. Steel liners in 6-ft sections, bolted together, were used near the surface to prevent cave-ins. Caisson reinforcing was lowered into position in the form of finished cages. The steel liners were raised as the concrete was placed; vibration was held to a minimum to prevent disturbance of the surrounding soil. Each caisson was topped with a square cap holding the anchor bolts for column connections.

Foundations for the towers are concrete pads 2½ ft deep, each supported on four caissons. The caissons are designed to carry uplift forces into the ground. Reinforcing bars are continuous from the bells to the foundation pads, where they are tied in with the reinforcing of the tower walls. Towers have walls 12 in. thick, with the reinforcing steel concentrated in the corners.

Slip forms for the towers had dimensions ranging from 8 ft to 18 ft. They were built 4 ft high, the vertical section being of ¾-in. plywood. The face to be in contact with the concrete was given several applications of lacquer. The sliding form was built ¼ in. wider at the bottom than at the top, to reduce friction and prevent the concrete from sticking to the form during lifting.

The outside forms were reinforced by timber wales with diagonal bracing between them, and the inside form was braced at the top by a working platform and on the bottom by stiffeners to prevent any change from the original shape. Corners were bolted. The two forms were held together by two bracket arms (inside and outside) mounted vertically to the wood form with a yoke across the top. Raising the form is done by hydraulic jacks that climb on a 1-in.-diameter rod, which is extended as the form rises. The jacks, about 3 ft apart, were mounted in the yoke in the space between the forms. Hydraulic lines from a central pump power the jacks but manual operation at each jack is possible.

The slip-form assembly had three levels. There was a working level on top of the forms, from which reinforcing was set and concrete placed. Above this was a frame against which long reinforcing rods could rest and on which the ½-cu yd hoppers were set. Elephant-trunk spouts led from the hoppers to the main platform and were directed to any spot needing concrete. A platform below the slip form was used as a scaffold for any finishing required. All vertical reinforcement had staggered splices to allow for continuous around-the-form work, which included the installation of electrical conduits and horizontal steel plates 8 in. wide for future connection to the slabs.

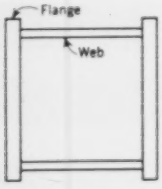
Concrete and materials were lifted into place by a Beatty Pecco crane, imported from Germany, and capable of erecting itself to its full height of 209 ft within 5 minutes. In varying positions the crane can lift up to 10 tons. The crane can be operated from several elevated positions or even remotely when needed. Its versatility is shown by its lifting speed of 230 fpm and by its ability to make a full-circle swing and to move back and forth on rails.

The three towers, 123 ft high, were concreted in ten 10-hour working days. Work proceeded on two towers at a time, so that each tower was worked on for two days, then skipped the third day while concrete attained strength to resist seismic forces. The rate of lifting was about 18 in. an hour. Great care was taken not to have a construction joint either near rein-

forcing splices or in areas of anticipated maximum shear. When the towers were completed, the crane lifted the whole slip-form assembly to the ground, where it was disassembled. Towers, checked at the end of construction, were found to be plumb within ⅜ in.

The total height of the building is approximately 113 ft from the basement level. Twenty steel columns of the box type support the structure. Column spacing varies from 19 to 25 ft in either direction and is a maximum of 38 ft in one instance.

The box-columns are a constant 12 in. square outside, with plates diminishing in thickness from 2 to 5/16 in. from bottom to top. Each column was fabricated in six "tiers" or lengths varying from 32 to 11 ft. The web plates of these column sections were set in, and shear plates were welded to



them. Lifting collars were slipped over the first tier of columns and they were set vertical on the basement slab before slab construction started.

Slab construction

The basement slab was poured first, extending over the whole area of the building and covering the base plates and anchor bolts. Side forms were then erected 8 in. high, which is the depth of the slab. The design required post-tensioning tendons spaced 36 to 40 in. in each direction. Stressing was done from one end of the tendons only. The end to be stressed was embedded in a box about 12 in. deep, which was filled with concrete after the tendons had been stressed. The fixed ends of the tendons were bolted to the form board, the wide end plate of which holds the wires in a flared position for maximum bond and resistance against concrete pressure.

There are from 6 to 14 wires of ¼-in. diameter in each tendon, which is covered with an asphalt emulsion and wrapped in tar paper for additional protection. At the stress end, the wires are separated and run through a steel washer about 1 in. thick, which is either undercut or threaded. The wires are then headed in a ball-like shape to prevent them from slipping through the washer when tensioning is introduced. After the tendons were placed in the designated grid system, they were positioned in a continuous elliptical curve, high at the column lines and low at midspan. Additional reinforcing steel was placed around columns, openings in the slabs, and around the perimeter of the slabs. Steel weldments at each column were also fabricated into the slab as the means for support.

The floor area is 8,100 sq ft, and 210 cu yd of concrete were placed in approximately 3½ hours. As screeds, 30-ft sections of steel pipe were used and constantly checked to give a level slab surface. The slab was cast with electrical conduits, pull boxes and water lines embedded. The finishing operation included the troweling in of Thompson water seal to facilitate slab separation when lifting occurred. The water seal effectively prevented bond between the previously placed concrete and the fresh concrete. Each slab required five working days for construction from start to finish.

No time lapse was needed between the finishing of one slab and the start of the next. Form work was held to a minimum and shoring was completely eliminated. The slab is made from lightweight (Haydite) aggregate, resulting in concrete weighing 110 lb per cu ft. The strength required prior to stressing was 3,500 psi, attained in 14 days, and a 28-day minimum strength of 4,000 psi.

While the upper slabs were being cast, the underlying ones were stressed and the stressing tendons permanently locked by shims inserted between the plate in the slab and the washer. The elongation of the tendons averaged 7 in. in 100 ft. Exposed tendon ends, washers and shims were then treated with an asphalt emulsion and the remainder of the void was filled with concrete.

Lifting operation

Lifting was done by the Vagtborg organization under a subcontract. Lifting equipment was mounted on the roof slab, the first slab to be raised. Two control panels were utilized, each handling ten columns. One 75-ton hydraulic jack was mounted on each column, and the lifting rods were then lowered into the lifting collar of the slab to be lifted. The schedule called for the lifting of two slabs at once, a total lifting weight of 1,200,000 lb. During the lifting operation each column indicator could be manually advanced or retarded to keep the rate of lifting uniform.

Slabs could be lifted at the rate of 8 ft per hour, depending on the size and the number of the columns. When the first two slabs had been lifted to the top of the first column tier, the lifting rods were lowered to pick up the next two slabs. Each set of slabs, when they arrived at a temporary station, were wedged off against the shear plates until picked up for the next lift. When the lowest slab was lifted to its final position, it was wedged off at its permanent shear plate and the wedge welded to the shear plate and the column.

Next the lifting jacks were removed and the column sections for the next tier were erected. Column settings had to be done carefully to eliminate any drag between the lifting collar and the column. The column sections for the remaining tiers were stacked on top of the roof slab to ride up with it and to be placed without any further delay. Column connections were hand welded and consisted of a V-bevel on all four sides. When the next tier of columns had been placed, the lifting jacks were put back and the lifting resumed. Two to three floors were permanently welded in each tier.

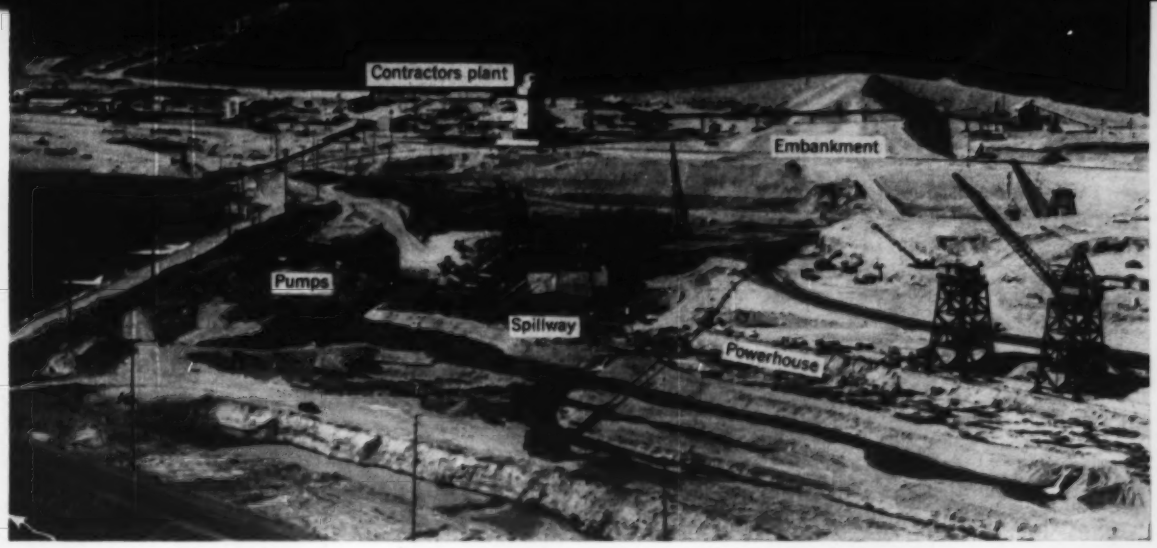
When all the slabs had been raised and anchored in their final position, the plates previously set into the slip-formed towers faced their corresponding slabs, which had a cast-in channel 6 in. wide. To provide for the transfer of shear from the slabs to the towers, a plate was set in the space between each tower and each slab and welded to both top and bottom with a continuous fillet weld. After lifting, slabs were checked and found to be level without deflection between supports, and the building plumb within 1/16 in.

Closure slabs and wall elements were concreted concurrent with the lifting, so that rough construction could be quickly finished. At the present time, less than twelve months after the start of construction, permanent partitions are being installed on the ninth apartment floor.

Efficient planning has resulted in substantial savings in materials and form work. Since the first slab was put in position, the open-frame building has been easily accessible for all installations and trades. Mr. Belcher estimates that a total saving of 30 percent in construction time will be realized.

The following companies have supplied equipment and services: B. M. Heede Corp., slip-form jacks, rods and miscellaneous equipment; The Prescon Corp., post-tensioning tendons and stress equipment; the Vagtborg Lift-Slab Corp., lifting equipment and lifting.

The architect was the late H. Baumann. The consulting engineer is A. E. Waegemann and Associates, with prestressing consultant T. Y. Lin, F. ASCE. The mechanical and electrical engineers are A. Gendler and Associates.



Wanapum Hydroelectric Development

C. K. WILLEY, F. ASCE, Vice President and Western Manager, Harza Engineering Company, Chicago, Ill.

The Wanapum Hydroelectric Development is the second element of a two-dam plan known as the Priest Rapids Project. The companion development, Priest Rapids, is of comparable magnitude to Wanapum and its construction is nearing completion. An outstanding feature of Wanapum construction is the use of a slurry cutoff wall, the first major application in the United States of this method to reach a depth of 80 ft in water-bearing material. Grouting by the sleeve-pipe method below the cutoff wall assures a stable structure. The narrow "future intake" structure is anchored down by 46,800 prestressed wires of ¼-in. diameter. It will serve as a diversion structure. The Public Utility District No. 2 of Grant County, with headquarters in Ephrata, Wash., is the owner of the Wanapum project and has a contract with several other utilities for the sale of power.

The Wanapum Development is on the Columbia River near the center of the State of Washington. See Fig. 1. The Columbia River profile, Fig. 2, shows the relation of Wanapum to other dams on the river between McNary Dam and the Canadian border. The Priest Rapids reservoir will encroach 4 ft on Wanapum tailwater, and the Wanapum reservoir, 7 ft on the tailwater of the existing Rock Island Dam, now owned by the Chelan County Public Utility District.

Engineering studies demonstrated that two dams would be more feasible for developing the nearly 150 ft of head between Priest Rapids and Rock Island than a single high dam, as previously proposed. Construction of the Priest Rapids Development was commenced in July 1956, utilizing funds from a revenue bond issue of $166,000,000. Initial generation commenced with partial head in October 1959, and full head was obtained in March 1960. Completion of construction, which includes ten units of 78,850 kw each, is expected by the end of 1960. The Wanapum Development is being financed by the sale of $195,000,000 of revenue bonds. Construction was commenced in July 1959 and is approximately 10 percent complete.

Bedrock in the Priest Rapids area consists of a succession of basalt lava flows with occasional, relatively thin, sedimentary interbeds. Individual flows range in thickness from less than 50 ft to several hundred feet. Melt-water floods at the close of the last glacial age carved channels at zones of weakness in the bedrock of the Wanapum Dam site up to 150 ft below the present river level. Permeable gravels, sands and silts deposited by the glacial floods and, near the top, by the modern river, occupy the zone between bedrock and the valley floor. High basalt escarpments form both abutments.

The major geologic structure of the Wanapum area is a simple homocline made up of basalt flows, which dip gently downstream. The detailed subsurface investigations included seismic

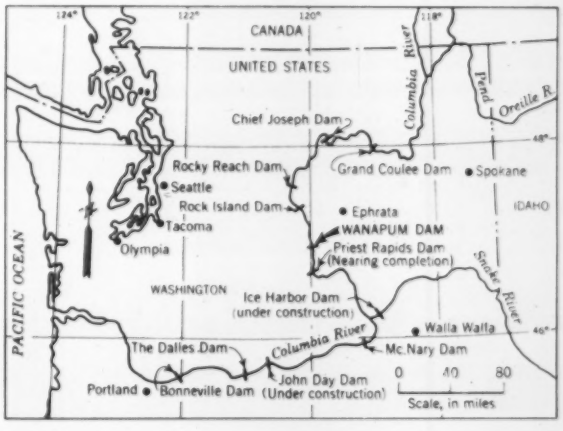


FIG. 1. The Columbia River, showing location of major power structures.

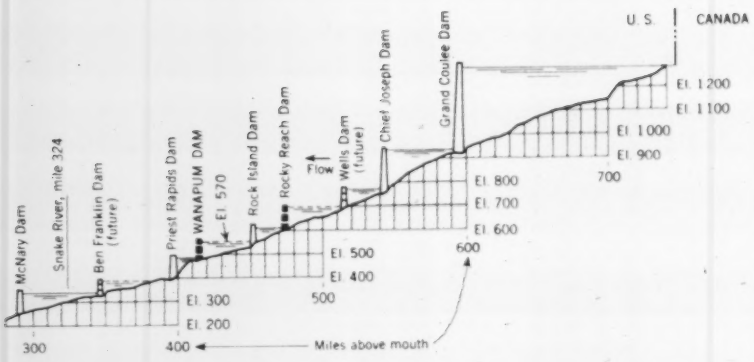


FIG. 2. Profile of the Columbia River. Note that there are sites remaining for only two more dams on the main river.

surveys and 300 drill holes. The basalt has adequate strength to support the concrete structures although it is somewhat permeable along flow contacts and open joints and requires grouting. The alluvial material in the valley floor has adequate strength to support the embankments but is permeable; a cutoff to bedrock is required.

Wanapum Dam will consist of 5,750 ft of earth and rock embankment, 424 ft of gravity section, 823 ft of deep-gated concrete spillway with a trash bay, 540 ft of intake structures for six future units, and 1,000 ft of powerhouse with integral intake, making a total length of 8,537 ft. The structures form a modified "S" as they cross the flood plain (Fig. 3). The embankments connect the concrete structures, located entirely on the right side of the river, with each abutment.

Fish ladders are provided at each end of the concrete structures and there is one pumphouse for fish-attraction water. The maximum controlled reservoir level will be El. 570 and the normal head about 80 ft.

Powerhouse with integral intake

The powerhouse is of the integral-intake type (Fig. 4). It will be fully enclosed and will contain ten generating units and an erection bay. The substructure will be of mass concrete founded on sound basalt with near-minimum rock excavation. The intake and semispiral case will be of reinforced concrete. The intake base will be a structural slab forming a part of a rigid frame joined with the piers and intake roof. The draft tubes, also of reinforced concrete, will be of the formed-elbow type. The powerhouse loads are carried to the foundation by the piers, and the downstream portion of the draft-tube base slabs will act as a paving slab only. The superstructure will be formed by the intake concrete wall, a downstream reinforced concrete wall, and a structural-steel roof deck—covered with 1½ in. of rigid insulation and built-up roofing.

Trashracks are designed for a maximum flow velocity of 4 fps through the gross area. Trash will be raked to the top of the intake deck and deposited in a truck for disposal; a ¾-cu yd clam bucket, operated from a jib boom on the bulkhead gantry crane, will handle debris.

Gates are provided for emergency or service closure of one unit. There will be three wheeled gates each 42 ft 6 in. high by 20 ft wide, one for each intake opening of one unit. The full set of three gates will be stored, transported, lowered, and raised by a single gantry crane with three 125-ton hoists. Upon closure of one unit by the wheeled gates, sliding bulkhead gates can be lowered by the 25-ton-capacity bulkhead gantry crane, thus freeing the wheeled gates for reserve use. Two sets of three bulkhead gates each are provided.

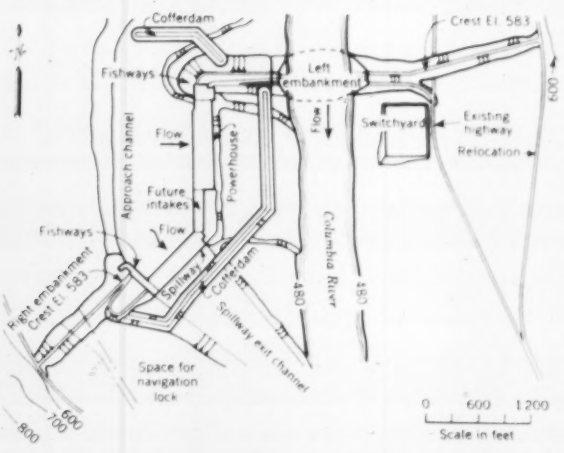
Draft-tube gates provide for the closing of the draft tubes of two units and will be handled by a 35-ton-capacity gantry crane. The gates are the vertical-lift, sliding type, of all-welded steel construction. Each gate is 21 ft wide and 27 ft high.

Generators are of the vertical-shaft, hydraulic-turbine-driven, totally enclosed type, rated 87,500 kva at an 0.95 power factor, 13.8 kv, three-phase, 60 cycle, 85.7 rpm.

The turbines will be of the vertical-shaft, adjustable-blade propeller (Kaplan) type, rated 120,000 hp at an 80-ft net head. Regulation of each unit will be provided by a cabinet-actuator, oil-

Cutoff-wall grouting is underway, utilizing several types of equipment.

FIG. 3. General plan of Wanapum Dam with the construction cofferdams.



Dragline excavating in the slurry trench. The side walls of the trench remained almost vertical through the use of the slurry method.

A belt-conveyor loader was used for rapid handling of excavated materials, an innovation that permitted excellent progress.

level to the underlying bedrock, a cutoff wall of impervious "slurry" material and a grout curtain provide a positive cutoff.

The slurry-trench method of providing a central cutoff wall to a depth of about 80 ft below the groundwater table was selected after extensive field tests had demonstrated its economy and suitability. The high permeability and unusual depth of the alluvial material made it impractical to unwater an excavation to bedrock and place a rolled impervious core in the dry. Tests with steel sheetpiling did not produce acceptable results. Other alternative cutoff methods were found to be relatively much more costly.

The slurry-trench method consists of digging a trench with the sides held vertical by a fluid mixture of bentonite and water. The backfill used is a mixture of fine soil and sandy gravel. Where bedrock is encountered in the slurry trench, 3 ft of concrete is placed on it in order to prevent erosion of the core material or the passage of groundwater through fractures in the rock.

Construction of the slurry-trench cutoff under the cofferdams and embankments has been completed except for the river closure section. General supervision of the slurry installation was handled by holders of the patent on the process, the Cronese Corporation. Since the Wanapum work represented the first major application in a dam foundation in the United States, new construction techniques were developed. This was accomplished without difficulty early in the operation and the construction proceeded quickly and efficiently.

The principal steps in the procedure were:

1. Mixing the slurry thoroughly with special equipment and storing it in a pit reservoir.
2. Simultaneously excavating the cutoff trench and keeping it filled with circulating slurry from the reservoir.
3. Placing the 3-ft layer of concrete on bedrock in the trench bottom.
4. Backfilling the trench with slurry-covered sand and gravel from the excavation mixed with added silt.
5. Providing a transition from the trench to the central rolled core of the embankment.

The trench was excavated with a dragline, the width depending generally on the width of the bucket. From experience at Wanapum it is concluded that the width can be held to no more than 2 ft greater than the bucket width, with vertical sides to a depth as great as 80 ft, and with only minor sloughing.

Concrete, where needed, was placed by lowering a bucket through the slurry and discharging from the bottom. An open bucket was found to produce less contamination than a bucket with a closed top. The surface of the rock in advance of the concreting was cleaned by a clamshell bucket and an air lift, and kept clean with an air jet. A layer of prepared impervious backfill was lowered in buckets and discharged onto the fresh concrete to a depth of 2 ft to minimize the deposition of sand from the slurry directly onto the concrete.

The initial backfill in the trench was placed with a clamshell bucket until the angle of repose was reached at the end of the trench, 300 ft or more behind the excavating operation. Thereafter the backfill was pushed outward along the trench by a bulldozer, advancing until the trench was completely refilled.

Next the upper 10 ft of the backfilled trench was re-excavated and gradually widened to 40 ft at the top to form a transition between the slurry cutoff and the rolled impervious core. The excavated material was then mixed with added impervious silt and backfilled to provide the transition and prevent any damage to the impervious core above from settlement of the slurry trench material.

Grouting for deep cutoff

A grouted cutoff wall is used to seal the gap between the bedrock and the bottom of the slurry trench wherever the latter is bottomed on alluvial material. The grouted cutoff consists of three parallel rows of grout holes at a close spacing to seal the voids in the sand and gravel. The outer rows of holes are grouted first; the center row is drilled and grouted later to supplement the original grouting and serve as a check on its adequacy. Measured amounts of grout are injected at regular intervals, the amount depending on void ratios in the material.

Injection is by the "sleeve-pipe" method, in which a hole is drilled; a pipe (perforated with a ring of ⅜-in.-diameter holes 1 ft apart) is set; and a weak grout is placed around the injection pipe. After this grout has set, injection begins at the bottom of the hole by setting a packer above and below a set of perforations. The weak grout around the injection pipe is ruptured by water pressure and fresh grout is pumped into the surrounding sand and gravel. In general, the grout pumped through each set of perforations is equal to 1½ or 2 times the calculated volume of voids in a theoretical cylinder of soil having a height of one foot and a diameter equal to the distance to the next grout hole.

pressure governor system with a minimum governor time of 6 sec.

Two electrically operated overhead cranes of 350-ton capacity each provide for handling the generating units during erection and for maintenance. Each has two traveling carriages equipped with a main hoist of 175-ton capacity and an auxiliary hoist of 30-ton capacity. The heavier lifts will require the two main hoists of both cranes. The crane will travel the entire length of the generator hall and erection bay.

Diversion through future intakes

The intake structure for the six additional units will serve as a low-flow diversion structure during final closure. The dimensions are identical with the same part of the initial powerhouse. The base width has been kept to a minimum. Stability will be established by post-tensioned BBRV-type anchors. Thirteen anchors are provided in each monolith, one in each of the four piers and three in each of the three intake slabs.

Each anchor consists of four 90-wire units. Each wire is of ¼-in. diameter and has an ultimate strength of 240,000 psi. The wires are button-headed and threaded through a steel bearing plate, grouted in the bottom of a drilled hole of 16-in. diameter, and have an anchor head at the jacking end. The design load on each anchor is 2,550 kips. A complete anchor was installed and satisfactorily tested in the field as a check on the ability of the anchor to sustain the design load. After river diversion, the intake will be closed with bulkhead gate sections.

Highest Tainter gates

The spillway will be a concrete structure with an ogee crest and a level concrete apron extending about 80 ft downstream of the ogee and terminating in a sill 4 ft high. The design of the spillway has been verified by hydraulic model tests. Twelve Tainter gates each 50 ft wide, with a damming height of 65 ft above the spillway crest, are provided. These gates are believed to be the highest Tainter gates fabricated.

The framing for the gates departs from conventional design by the insertion of vertical girders between the horizontal beams and the radial arms. With this framing system only two radial arms are required on each side of a gate. Each gate will be operated by an individual hoist. The spillway is capable of discharging, with 5 ft of surcharge, the maximum design flood of 1,400,000 cfs, about twice the flood of record.

A trash sluice with a hydraulically operated gate of 20-ft clear width is provided at the left end of the spillway to pass trash that may accumulate in front of the powerhouse. The bridge over the spillway will provide a concrete roadway 12 ft wide and walkways each 3 ft wide.

Two fish ladders, each 16 ft wide, are of reinforced concrete construction and consist essentially of a series of 10-ft-long pools with weirs, which will provide 1-ft steps between pools. They will be fed by water taken directly from the reservoir surface. During spillway operation only, additional attraction water will be supplied at the lower entrance to the right-bank ladder by gravity from headwater.

A fish collection system in the powerhouse above the draft tubes will serve the left-bank ladder. Supplemental attraction water will be pumped from tailwater by two small hydraulic turbine-driven pumps, the turbines being connected by penstocks to headwater. The water used by the turbines will supplement the attraction supply.

Slurry cutoff

The left and right embankment sections of the dam will consist of an impervious central core with upstream and downstream pervious shells of river gravels and sand, or rock from required excavations. The shells will be founded on the alluvium. The central rolled impervious core will extend through these gravels to just above the groundwater table, and will be separated from the shells by a zone of transition fill 9 ft wide, both upstream and downstream (Fig. 5). From this

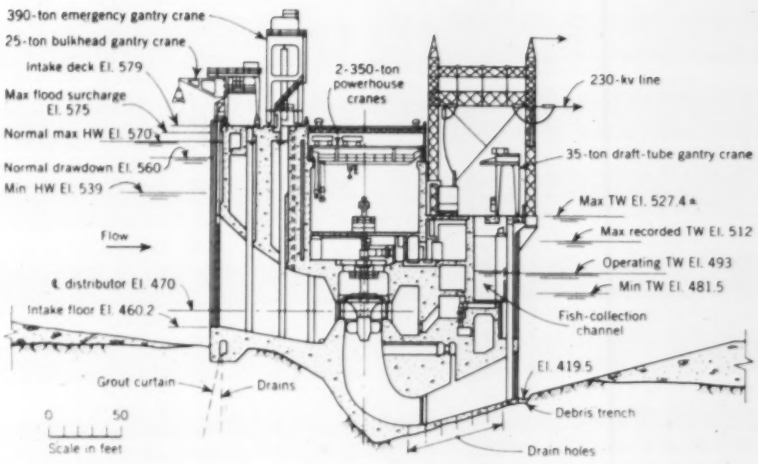
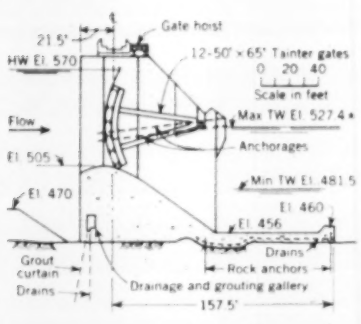
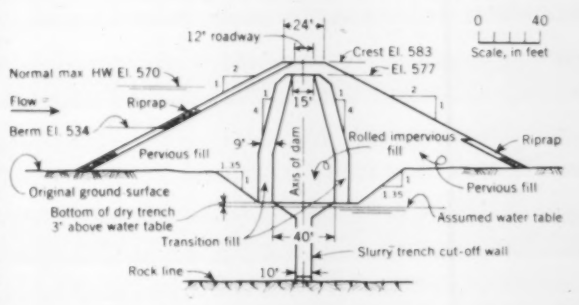


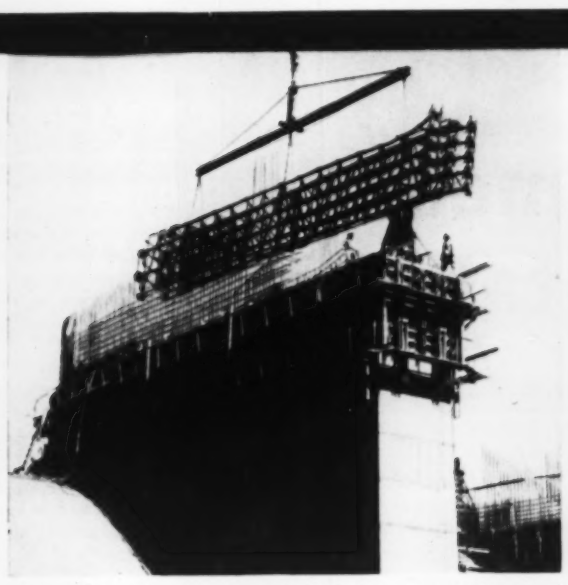
FIG. 4. Transverse section through the powerhouse. Normal operating head is 80 ft.



◄ FIG. 5. Tainter gates 65 ft high for the Wanapum spillway are believed to be the highest ever used.



► FIG. 6. A trench as much as 80 ft deep was excavated 10 ft wide under water and kept from sloughing by a thick slurry. Local materials were found suitable for fill sections.



Prestressed anchorage assemblies for the spillway piers were manufactured and assembled by the Joseph T. Ryerson Co.

A large assembly of machines in a limited area speeded work on the spillway section.

This system of grouting has the advantage of (1) permitting the injection of grout into limited areas, thus preventing grout wastage into very pervious zones, and (2) permitting regrouting of the holes in zones where initial grouting has not sealed the zone. Experience at Wanapum indicates that this method provides a very satisfactory cutoff in the coarse Columbia River gravels, with a minimum of injected grout.

The embankments have a slope of 2 horizontal to 1 vertical. The upstream face of the dam will be protected by dumped riprap 3 ft thick extending to 5 ft below the minimum drawdown level, with a 2-ft thickness extending to the foundation. Riprap 2 ft thick will protect the downstream face to the tailwater level of the design flood.

The embankment structure was analyzed for stability by the sliding-wedge and slip-circle methods of analysis. It was found to be stable under all operating conditions, including flood surcharge, drawdown, and an earthquake acceleration of 0.1 gravity.

Dam construction

The successful bidder for the general construction contract was Grant County Constructors, a combine of Morrison-Knudsen Co.; Henry J. Kaiser Co.; Macco Corp.; Raymond International Inc.; and the F. & S. Contracting Co., with a bid of $93,277,690.50. The majority of the permanent equipment required in the development is to be purchased and installed by the contractor. This includes the generators, turbines, governors, cranes, and all major gates.

Full completion is required by January 1, 1965, with a minimum of six units installed and ready for commercial operation by September 1, 1964. Actual construction was commenced in July 1959. For early completion of the first four units the contractor can earn bonuses that could amount to about $1,500,000.

Excellent natural construction materials are available at the site. The sand and gravel in the Columbia River terraces are suitable for concrete aggregate and filter materials. The required excavation will supply substantial percentages of these requirements. Extensive deposits of excellent silt for impervious core and slurry-trench backfill occur on both sides of the river. The basalt from the powerhouse rock excavation or from exposed flows in both abutments will make excellent riprap.

Pozzolan is used extensively in the concrete mixes. Deposits of volcanic ash with pozzolanic properties are widespread in the area. One deposit was developed by an independent supplier for the Priest Rapids Development, 18 miles downstream, and is the source of supply for Wanapum.

River diversion

The layout of the development, in which all the concrete structures are on the right side of the river, permits construction within a single cofferdammed area (Fig. 3). Maximum use is made of the permanent embankments, which were constructed as a first operation. The basic design of the contractor's cofferdams duplicated, for all practical purposes, the design of the permanent embankments, including the use of slurry-trench construction below the water table.

Final river closure will be one of the contractor's last major construction operations on the dam. The embankments, except for the river section, will be constructed early. Final closure will await substantial completion of the main dam, removal of the cofferdams, and completion of the approach channel and tailrace excavations under them. Closure will be accomplished by placing heavy rock in the river channel, with the low flow of the river diverted via the approach channel through the future unit bays, and through the tailrace to return to the river. The river section of the left embankment will be completed immediately after diversion.

The diversion plan has an additional important advantage in that it does not require any temporary fish ladders during construction, an item of considerable expense at many other Columbia River dams, including Priest Rapids.

E. B. Gibbons is the manager, and R. R. Ries supervisor of production, for the Grant County Public Utility District. George Piedmont of Morrison-Knudsen Co., the sponsoring contractor, is project manager for Grant County Constructors.

The Harza Engineering Company is the consulting engineer for the District on the design and supervision of construction. R. B. Jackson, M. ASCE, is resident engineer for Harza.

Equipment Suppliers

Manufacturers of major items of equipment are:

Generators	General Electric Co.
Turbines	Dominion Engineering Works Ltd.
Governors	Baldwin Lima Hamilton Corp.
Spillway gates and hoists	Yuba Mfg. Div.
Intake gate cranes	Yuba Mfg. Div.
Powerhouse cranes	Yuba Mfg. Div.

(This article is based on the paper prepared by Mr. Willey and presented by Donald P. Roberts, F. ASCE, at the ASCE Reno Convention, before a session of the Power Division.)

Power development in the United States

FRANK L. WEAVER, F. ASCE, Chief, Division of River Basins, Bureau of Power, Federal Power Commission, Washington, D. C.

Power production in the United States in 1959 was 795 billion kwhr, or about 14 times the output in 1920. More than 60 percent of the increase during this 39-year period took place in the last decade. The estimate for 1980 is 2,150 billion kwhr, or 2.7 times the requirement for 1959. Some 315 million kw of new capacity will be required in the next 21 years, an average of 15 million kw each year.

Our high standard of living and our capacity for industrial production are due in large measure to an ample supply of electric power. We have become accustomed to turning on switches and expecting our electrical requirements to be fulfilled and, especially in the home, we are quite put out if they are not. Fortunately, the power industry has met the challenge of supplying our requirements in the manner we expect, so the term "power shortage" is now heard only in very rare instances and then usually in regard to local emergencies caused by natural forces or mechanical failures. This has been done economically by technological improvement. There have been some increases in electric power rates in recent years, but the average bill for residential electric service in 1959 was slightly less than the average for an equivalent number of kilowatt-hours in 1940.

Future needs estimated

Current requirements by various consumer classifications, such as home, commercial, and industrial, are obtained annually from utility reports, public and private, to the Federal Power Commission. Staff engineers analyze these reports to make estimates of future requirements by individual areas and regions. These electric energy requirements are combined into national totals as shown in Fig. 1.

While the FPC estimate of 2,150 billion kwhr for 1980 provides for a very large growth in requirements, most estimates by representatives of the industry are still higher. For example, a recent report of the Edison Electric Institute estimated electric energy requirements at 2,895 billion kwhr for 1980. The FPC estimate of 2,150 billion kwhr is used here. It is unimportant at this time whether requirements of this magnitude are reached in 1980 or at a somewhat earlier or later date.

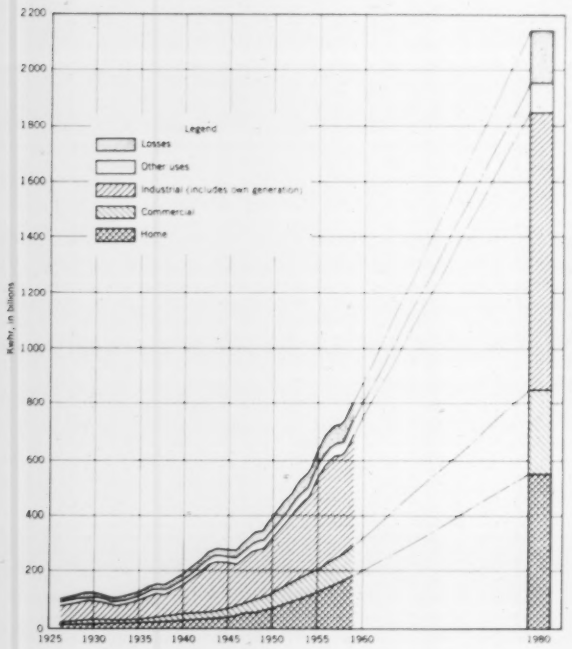


FIG. 1. Growth of electric energy requirements by type of use in the United States is plotted from 1926 to 1959, and estimated to 1980.

Having estimated the magnitude of future electric energy use for a particular year, it is not difficult to establish the total generating capacity that will be required at that time. This is done by load-factoring, or converting, the energy requirements to peak loads, and then adding about 15 percent to provide required reserve capacity. On that basis the total needed capacity of the country in 1980, excluding Alaska and Hawaii, would be about 450 million kw, compared with the 1959 total of 174 million kw. Including an allowance of 39 million kw for existing capacity that will probably be retired because of age and obsolescence, a total of about 315 million kw of new capacity will be required in the 21-year period 1960 through 1980. To provide this amount of additional capacity, new installations will have to be made at an overall average rate of 15 million kw annually.

The installed capacity at the end of 1959 amounted to 32 million kw of hydroelectric capacity and 142 million kw of thermal capacity. Of the latter, 138 million kw were in conventional steam-electric plants and the remainder was internal combustion except for an insignificant amount of gas-turbine and nuclear-power capacity. Internal-combustion and gas-turbine capacity will continue to be a very minor part of the total generating capacity. For the next 20 years, most of the new capacity will be hydroelectric, conventional steam-electric and nuclear.

Hydroelectric capacity

The Federal Power Commission makes studies and assembles data on the hydroelectric power resources of the United States, both developed and undeveloped. The estimates of the undeveloped power are made from the practical point of view in contrast to the purely theoretical approach sometimes used, especially in terms of world hydro power resources. The estimates

are based on the rated capacity of generators that normally would be installed for use, in conjunction generally with thermal power sources, in expected loads at practicable power sites, that is, sites apparently having engineering feasibility.

Allowance is made for depletions by irrigation and other consumptive use. It is assumed that each site would be developed to achieve, in conjunction with the development of other sites, the best overall development of the water resources of the river basin for power and other multiple uses.

As of January 1, 1960, the total potential hydroelectric power of the 48 states, excluding Alaska and Hawaii, was estimated to be 126 million kw, of which 32 million kw were developed and 94 million kw were undeveloped. The 94 million kw of undeveloped hydroelectric capacity include 12 million kw in the construction stage, 25 million kw in various stages of planning, and 57 million kw of other undeveloped capacity.

In round numbers, the 25 million kw of undeveloped hydro in various stages of planning include the following: 4 million kw in projects under Federal Power Commission licenses but not under construction, together with additional planned units at developed projects; 9 million kw in applications for licenses or amendments of licenses pending before the Commission; 3 million kw in preliminary permits outstanding or in applications for such permits pending before the Commission; and 9 million kw authorized for construction by federal agencies, together with additional units planned at developed projects. With the completion of the 37 million kw of hydro capacity in the planning and construction stages, the total developed capacity will be 69 million kw, or 55 percent of the total potential hydro resources. It appears reasonable to expect that this stage of development will be reached by 1980.

Pumped-storage and thermal projects

The most significant development in hydro projects to be constructed in the near future will be the construction of large "pumped-storage" plants. Where a favorable site is available, all or nearly all of the available water can be recirculated by use of off-peak generation at times at run-of-the-river hydro plants but generally at thermal power stations.

There will be a need for 315 million kw of new capacity by 1980. If that estimate and the estimate of 37 million kw of new hydroelectric capacity by 1980 are realized, then the new thermal capacity required will total 278 million kw.

How much of the new thermal capacity will be nuclear and how much conventional steam-electric depends largely on the progress made in bringing nuclear power costs down to the level of those at conventional plants. It seems reasonable to expect the capacity of nuclear power plants to total about 50 million kw in 1980, about 16 percent of the new capacity needed.

The nuclear reactor is simply a substitute for the boiler in the conventional steam-electric plant and, to be competitive, it must have an annual cost not greater than that of a boiler, including the cost of fuel. None of the nuclear power plants at present in operation or under construction is expected to produce economically competitive power. It is anticipated, however, that competitive nuclear power will be produced in a few years in areas where cost of fossil fuels is relatively high.

Major advances

The conventional steam-electric plant will continue to be the predominant source of new power supply during the next 20 years and will probably contribute at least 70 percent of the new capacity during that period.

Important developments in these plants include: higher operating steam pressures and temperatures; unit type construction (one boiler per turbine-generator); outdoor and semi-outdoor types of construction; increased size of generating units; centralized automatic operating controls for the boiler and turbine-generator and their auxiliaries; and the substitution of metal siding, precast wall panels, and the like, for the more expensive brick and stone masonry in plant structures. Advances in the art of producing power from such plants have been tremendous over the years and the end is not in sight. For example, in 1920 the average plant consumed 3.00 lb of coal for each kilowatt-hour; in 1930 1.60 lb; in 1950, 1.19 lb; and in 1959, 0.89 lb.

Increases in the size of steam-electric units have been as outstanding as improvements in efficiency. For example, as recent as 1948 the largest steam-electric unit operated by the Arkansas Power & Light Company had a capacity of 25,000 kw, yet in March of 1961, this company is scheduled to have in operation a single unit of 325,000 kw. Ten years ago the largest unit operated by the Tennessee Valley Authority was rated at 60,000 kw. Today, TVA has three units of 500,000 kw each and one unit of 600,000 kw scheduled to be in operation before the end of 1963. The latter will be the largest single generating unit ever built. With compound-type multi-flow units there appears to be almost no limit to the size of units. By 1980, units of a million kilowatts may be common.

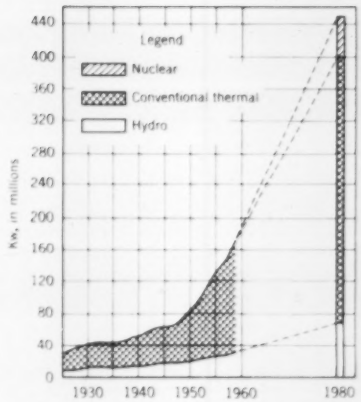


FIG. 2. Installed capacity of electric generating plants in the United States—utility and industrial—is plotted from 1925 to 1959, and estimated to 1980.

In addition to having the largest unit under construction, the TVA already operates the two largest steam-electric plants. These are the Kingston and Shawnee plants, with installed capacities of 1,440,000 and 1,350,000 kw, respectively. Thus, in the short period of ten years, TVA changed from a predominantly hydro system, with 83 percent of its capacity in hydroelectric plants, to a predominantly thermal system with 74 percent of its capacity in steam-electric plants.

A recent industry advance has been the installation of electronic computers in the load dispatching centers, the engineering offices, and the generating plants. Computer control is so advanced that the first so-called fully automatic steam-electric plant is under construction, the Little Gypsy plant of the Louisiana Power & Light Company, which will be started, stopped, and put back in operation automatically through an elaborate electronic computer system.

Many of the new and larger plants will be located at the source of fuel or at a favorable site for cooling water rather than at a load center. Therefore it will be necessary to transmit large blocks of power over long distances, an impetus for the introduction of extra-high-voltage transmission in the 460-kv to 750-kv range. Such transmission voltage levels could reduce the cost of power at market, particularly where the cost of fuel is high. This would be another important factor affecting the rate at which nuclear capacity will be added in the future.

Data for Alaska and Hawaii are not included in the accompanying figures because the necessary information was not available. The inclusion of Alaska

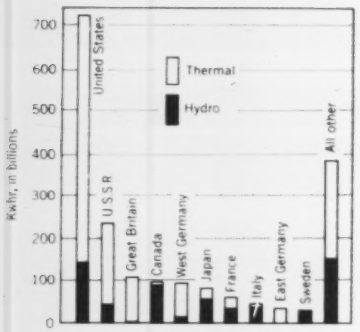


FIG. 3. Data are plotted for ten largest power producing countries for 1958.

would add substantially to the hydroelectric power resources of the United States. Preliminary studies indicate that our 49th state has hydro resources totaling at least 18 million kw. At present Alaska has about 400,000 kw of generating capacity, of which about 70,000 kw are hydro. The present generating capacity in Hawaii totals about 450,000 kw, of which 20,000 kw are hydro. Hawaii's total potential hydro capacity is estimated at 300,000 kw.

World power data

How does United States power production compare with that of other countries of the world? Figure 3 shows the ten largest power producing countries for the year 1958 and the following tabulation lists the ten countries having the highest kilowatt-hour production per capita, whose population exceeds 3,000,000:

	KWHR		KWHR
Norway	7,708	Great Britain	2,083
Canada	5,640	Australia	2,077
United States	4,159	Germany, East	1,993
Sweden	4,102	Austria	1,958
Switzerland	3,443	Finland	1,803

In 1958, United States plants, the largest producers, generated 38 percent of the world's electric energy production of nearly 1,900 billion kwhr. The USSR was the second largest producer, with about 12 percent of the total. About 20 percent of the United States production, and 19 percent of the Russian production, was from hydro plants. On a world-wide basis, hydroelectric energy production amounted to about 31 percent of total production, thus reflecting the fact that in many countries, such as Canada, Japan, Italy, and Sweden, hydroelectric plants are the main source of electric power.

The above tabulation shows that in 1958 Norway, with 7,708 kwhr per capita, ranked first in production per capita. Canada and the United States ranked second and third with production per capita of 5,640 and 4,159 kwhr respectively. Of the ten countries with the greatest energy production, the USSR, Italy, and Japan ranked lowest, with 1,115 kwhr, 911 kwhr, and 870 kwhr per capita, respectively.

In recent months a popular pastime has been to predict that the USSR will, or will not, soon overtake the United States in electric energy production. So far, the evidence is that the United States is widening its lead over the USSR. For example, production in the United States increased from 725 billion kwhr in 1958 to 795 billion kwhr in 1959, an increase of 70 billion kwhr. For the USSR, preliminary figures for 1959 are 262 billion kwhr, an increase of only 29 billion kwhr over the 1958 production.

In Fig. 4 production in the United States and the USSR are compared through 1959. An estimate is given of United States production in 1975, and a corresponding figure for the USSR given at one of the technical sessions of the World Power Conference in Montreal, Canada, in September 1958 by A. S. Pavlenko, who at that time was Minister of Power for the USSR. Mr. Pavlenko's figure of 900 billion kwhr in 1975 was given as the Russian objective for that date. It is exactly one-half of our estimate of 1975 United States production of 1,800 billion kwhr.

The February 1960 issue of the magazine *Power* summarizes a translation of Nikita Krushchev's speech at a recent All-Union Power Development Conference in Moscow. Mr. Krushchev gave the present output goals of the USSR as 900 billion kwhr by 1970, 1,500 billion by 1975, and 2,300 billion by 1980.

A look at Fig. 4 shows that the margin between the United States and USSR production has increased steadily. Actual United States production exceeded USSR production by 132 billion kwhr in 1940, 298 billion in 1950, and 533 billion in 1959. If the USSR were to equal our estimated United States production in 1975, an annual growth in production of 96.1 billion kwhr would be required. To date, their maximum one-year growth has been 29 billion kwhr. In contrast, the United States can reach our 1975 estimate of production with an annual growth of 62.8 billion kwhr. To date, the maximum one-year increase in electric energy production in the United States was 84 billion kwhr, which occurred in 1955.

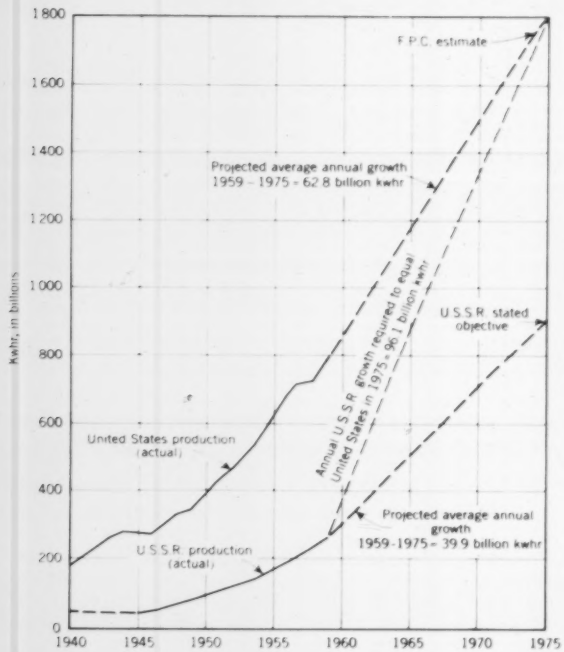


FIG. 4. Production of electric energy in the United States and in the USSR are compared, with predictions through 1975 plotted.

In closing I would like to mention the valuable assistance of James J. Stout, F. ASCE, in the preparation of this article. The figures are from the Federal Power Commission's Bureau of Power.

The Federal Power Commission, as a matter of policy, disclaims responsibility for material published unofficially by any of its employees. The views expressed in this article are those of the writer and not necessarily those of the Commission.

(This article is taken from the paper presented by Mr. Weaver at the ASCE Reno Convention, before a session of the Power Division.)

Design chart for vertical stress under square footings

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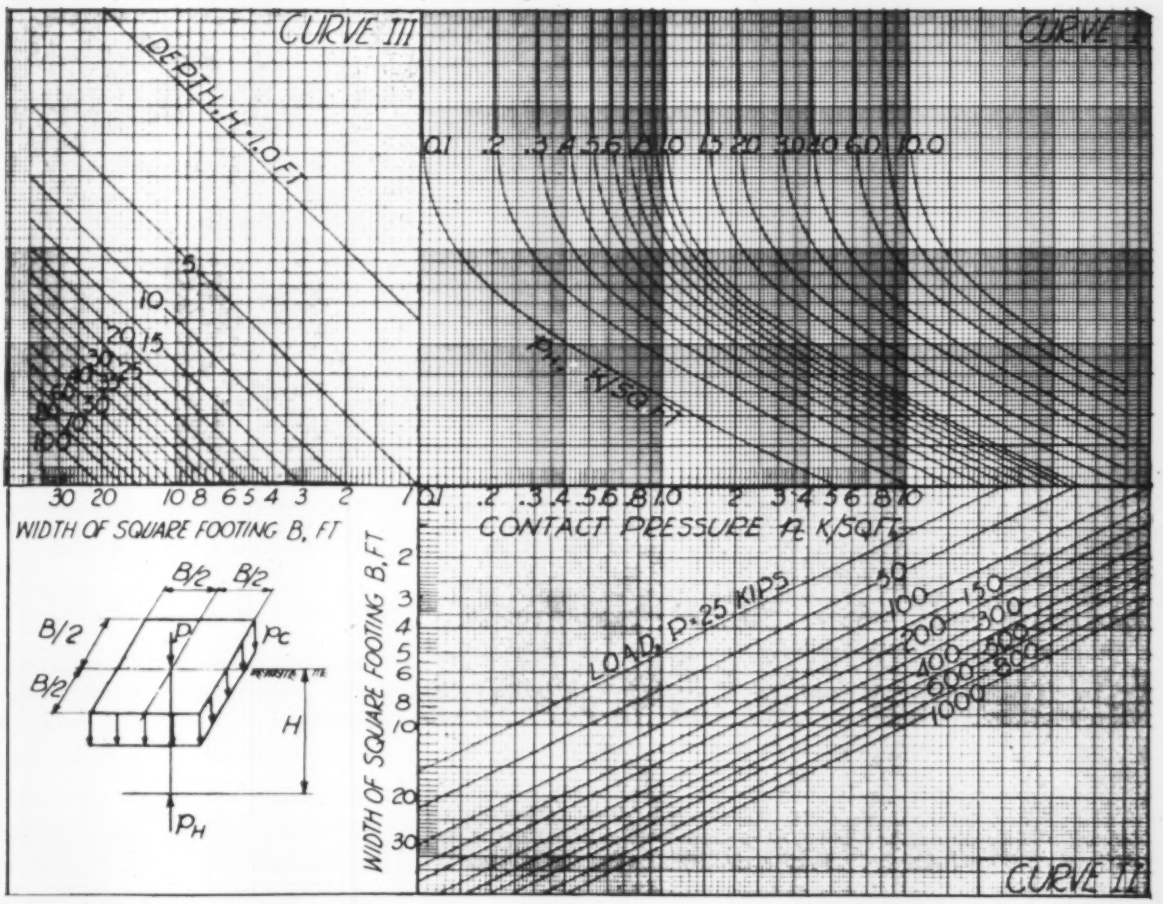
Vertical stress calculations play an important role in foundation design when a soft stratum is present at a lower depth and when it is necessary to predict the probable settlement under a loaded area. Square footings are assumed in this discussion because of their economy and frequent use. The following expression has been derived by a modification of the formula of Nathan M. Newmark, F.ASCE, Research Professor of Structural Engineering, University of Illinois, given in his paper, "Simplified Computation of Vertical Pressure in an Elastic Foundation" (Circular No. 24, Engineering Experiment Station, University of Illinois, 1935).

FIG. 1. Design chart for vertical stress under square footings.



$$p_H = \frac{P}{\pi B^2}\left[\frac{4\,m^2\,(2\,m^2+1)^{1/2}}{(m^2+1)\,(2m^2+1)} + \sin^{-1}\frac{2m^2\,(2m^2+1)^{1/2}}{(m^2+1)^2}\right]$$

in which p_H = vertical stress or pressure at a distance, H, below the center of a square footing, kips per sq ft

P = concentrated load, kips

B = width of footing, ft

H = distance below center of footing, ft

p_c = uniformly distributed contact pressure, kips per sq ft

$m = B\ (2\ H)$

Since the physical properties of soils vary and may differ widely from the hypothesis of the elastic theory, engineers making such an analysis must bear in mind the degree of approximation in the final result. It is important to allow designers to use the formula at least in a simplified and rough way for practical purposes, and the method will no doubt lend itself to progressive improvement as knowledge and experience increase. Two numerical examples illustrate the use of the chart, Fig. 1.

Example 1. To determine the vertical stress, p_H. Given $P = 400$ kips; footing size, 8 ft × 8 ft, or $B = 8$ ft; depth, $H = 20$ ft.

Enter Curves II and III of Fig. 1 simultaneously with $B = 8$ ft to intersect the load line, $P = 400$, and the depth line, $H = 20$, respectively. Vertical and horizontal lines are drawn and extended to Curve I. The intersection — interpolating between lines when necessary — is the required $p_H = 0.45$ kips per sq ft.

Example 2. To select the proper size of a square footing, when the laboratory test of boring samples discloses weaker soil at a distance of 20 ft below the proposed footing. To reduce settlement to a minimum, the vertical stress is restricted to approximately 0.20 kips per sq ft under a load of 170 kips.

From Curve I of Fig. 1, a point is chosen along the stress line such that $p_H = 0.20$. Vertical and horizontal lines are drawn and extended to Curves II and III respectively, intersecting load line $P = 170$ (interpolate between lines) and depth line $H = 20$. Read the width-of-footing scale, showing that $B = 6$ ft is the answer in each case. If the readings do not agree, another point is chosen along the stress line in Curve I, and the procedure is repeated until, by trial and error, they do agree.

The chart provides a visual picture for designers, and its versatile nature saves considerable time and tedious work.

THE READERS WRITE

Experience with expansive clays in South Africa

To the Editor: I read with interest Forrest D. Clark's article, "Experience with Expansive Clay in Peru" (May issue, p. 42), as we in South Africa have a similar problem extending over a major part of our high inland areas. However, it would seem from the photographs accompanying the article that the degree of expansiveness in Peru would not be classified as severe in Africa.

I would like to challenge Mr. Clark's conclusions on how to deal with expansive clay—"remove it or keep it absolutely dry." In South Africa we have on occasion successfully removed shallow layers of redeposited clay beneath house foundations; but it has long been realized that any attempt to "keep it dry" is doomed to failure, although it is a theoretically correct conclusion.

Our National Building Research Insitute has done a considerable amount of work on these clays, especially in connection with new gold mining towns built on very thick deposits of highly expansive residual clay.

It was realized here many years ago that the act of covering an open area caused moisture migration and a consequent increase in moisture content below the area. Heaving movement has even been found in black-top roads due to this cause. Where heaving is not severe, however, it is frequently found that the effect of moisture migration on a house is not great, but it may cause cracking in sewer pipes with consequent leaks which produce a marked local heave.

Engineers who have to deal with this problem could profit from South African experience by reading our publications, especially the recent "Symposium on Expansive Clays" obtainable from the South African Institution of Civil Engineers, P.O. Box 1183, Johannesburg, South Africa, at £1.1.0.

W. Irvine Low
Kantey, von Geusau & Partners
Consulting Civil Engrs. and
Eng. Geologists
Cape Town, South Africa

Tidal waves are low in the open ocean

To the Editor: In the News Briefs section of your July issue, p. 88, an article appeared on the recent Chilean earthquakes and the tidal waves (tsunami) resulting from them. Some of the statements in this article may be subject to misleading inferences by engineers unfamiliar with such phenomena.

Tidal waves generated by earthquakes are almost without exception quite low in the open ocean, probably never exceeding two or three feet in height. There, since depths are quite great, these waves, whose velocity is proportional to the square root of the depth, travel with speeds on the order of 525 miles per hour, as mentioned in your brief.

It is only in relatively shallow water near or at the coast line that large wave heights are reached by these waves. These higher heights in shallow water are caused by the shoaling bottom (as, for example, the piling up of water as the faster-moving back part of the wave in deeper water catches up with the front part, moving more slowly in shallower water), by refraction effects, by physiographic effects (such as funneling), and by excitation of a harbor or bay to one of its resonant periods. And incidentally, it is entirely possible that the latter of these effects was the one primarily responsible for the large wave at Hilo, with considerably lower wave elevations being recorded over much of the rest of the Hawaiian coast.

Since the speed of these waves depends primarily on the water depth, the waves in shallow water, though much higher than in the open ocean, move at much slower speeds—more on the order of 15 to 30 miles per hour. Some estimates of the speed of the wave at Hilo, after it reached the shoreline, have been on the order of 20 to 30 ft per sec, or about as fast as a man can run for short distances.

Thorndike Saville, Jr., M. ASCE
Asst. Chief, Research Div.
U.S. Beach Erosion Board
Corps of Engineers, U.S.A.
Washington, D.C.

Graphical solution for penstock sizes corrected

To the Editor: I would like to call your attention to the following typographical errors which appear in my article in the July issue, pp. 70-71.

1. The full title of my article, "Graphic Solution for Economic Sizes of Steel Penstock," should be changed to "Graphical Solution for Economic Sizes of Steel Penstocks."

2. The notations being used in this article, except f, should be written in a similar style of capitals—roman or italic—to keep it consistent.

3. At the end of the first column on page 71,

"The expression for economic size is then

$$de = F\ de'$$

should read

$$D_e' = F\ D_e$$

Francis S. Y. Lee, F. ASCE
Ebasco Services, Inc.
New York, N.Y.

ASCE NEWS

Life Insurance Plan Reduces Requirements

The new approved Group Life Insurance Plan available to the members of ASCE, which has been in force since March 1, 1960, closes its charter enrollment period on October 31. The new plan, approved by the Board of Direction in October 1959, was discussed in the February 1960 issue (page 60).

After a careful review of the applications already received, the New York Life Insurance Company has agreed to reduce the original requirements. It is offering to all members, under age 40, the possibility of securing coverage regardless of their medical history, if 800 additional members apply for this protection before October 31.

The only exception to this liberal offer is that it excludes new members joining the Society between September 1 and October 31, 1960. The reason for this exclusion is to keep prospective members with unfavorable medical histories from taking advantage of the opportunity. New members joining the Society between these dates, can apply for the Group Life Plan and will be accepted if their medical history is satisfactory.

It is suggested that members who have not, as yet, availed themselves of this opportunity, consider doing so before the close of the Charter Enrollment Period on October 31.

A mailing with further details is being sent to all members.

D. B. Steinman, Famous Bridge Builder, Dies

David B. Steinman, F.ASCE, New York City consultant and internationally known bridge builder, died in New York on August 21. Regarded as one of the great engineers of the twentieth century, Dr. Steinman had designed over 400 bridges in all parts of the world. One of the most famous was the recently completed Mackinac Straits Bridge connecting the Upper and Lower Michigan Peninsulas.

Among other bridges designed by Dr. Steinman were the Sydney Harbor Bridge in Australia; the Thousand Islands Bridge over the St. Lawrence; and the Kingston-Rhinecliff Bridge over the Hudson. His projects in the New York metropolitan area included the Henry Hudson Bridge and the reconstruction of the Brooklyn and Manhattan bridges. Recently his designs were accepted for a bridge joining Europe and Asia across the Bosporous at Istanbul, Turkey. Eight of his bridges received awards for their beauty.

A graduate of the City College of New York, he won his engineering doctorate at Columbia in 1911. In 1923, after teaching briefly at the University of Idaho and the City College, he became connected with the late Holton D. Robinson, M.ASCE, in the New York consulting firm of Robinson & Steinman. After Mr. Robinson's death he continued the firm, which this past January became a partnership—Steinman, Boynton, Gronquist & London.

A member of ASCE for half a century, Dr. Steinman had been chairman of the Structural Division and active in committee work. His numerous TRANSACTIONS papers won him many ASCE honors, including the Norman Medal in 1951. In 1959 he received the recently established Ernest E. Howard Award for "his contribution toward the advancement of bridge analysis and design, the theory of the suspension bridge and its aerodynamic stability, and especially his outstanding work in the design of the Mackinac Bridge."

It is impossible to list the many other honors heaped on Dr. Steinman or to make note of his many activities. He was a founder and first president (in 1934) of the National Society of Professional Engineers. He also did much to promote the adoption of registration as a prerequisite to engineering practice.

Civil Engineer's Role in Urban Renewal Discussed

A recent meeting of the ASCE Committee on Urban Renewal was directed toward stimulating the civil engineering profession to assume its rightful role of leadership in city revitalization. The program emphasized that the urban renewal process is primarily a civil engineering function. Working with the Urban Renewal Administration, the committee will conduct a survey of urban renewal activities with primary emphasis on the civil engineer's part in the nationwide program.

William H. Claire, urban renewal and planning consultant of Pasadena, Calif., is chairman of the Society's Committee on Urban Renewal. Other committee members in attendance were Everett B. Mansur, planning consultant of San Gabriel, Calif., and chairman of the executive committee of the City Planning Division; Robert E. Barkley, director of redevelopment of Greensboro, N. C.; Richard L. Dickman, urban renewal and planning consultant of Cincinnati; and Eldridge Lovelace, of Harland Bartholomew and Associates, St. Louis. The committee chose St. Louis for its first meeting because of its "extraordinary progress in carrying out the spirit of urban renewal."

Engineers and Architects In Bahamas Form Society

Engineers and architects in Nassau, the Bahamas, have joined forces to establish the Bahamas Society of Engineers and Architects, the first technical society of its kind ever to be formed in the Bahamas. The objectives of the organization, as stated in the constitution, are:

1. The advancement of the professions of engineering and architecture in the Bahamas.

2. The safe-guarding of the public through the promotion of the professional and ethical standing of its members.

3. The promotion of licensing legislation for engineers and architects in public practice.

4. The encouragement of education and training for entry into the professions of engineering and architecture and allied professions.

Officers of the group are E. A. Boyce, president; Cuzon Dobell, M.ASCE, vice president; and Holland G. Smith, A.M.ASCE, secretary-treasurer.

Electronic Computer Applications

In this issue CIVIL ENGINEERING continues its series of descriptions of applications of electronic computers to the solution of civil engineering problems. These descriptions have been prepared from information assembled by the Task Committee on Program Directory and Library of the Structural Division's Committee on Electronic Computation. The series is appearing in alternate issues (see the July issue, page 78).

To assist the Task Committee in its aim of assembling a comprehensive directory of computer applications in the structural engineering field, readers are invited to send information to: John J. Kozak, ASCE Task Committee, P.O. Box 1499, Sacramento 7, Calif.

Program St. 41: Beam deflections
Equipment: IBM 650.
Programmed by: State of Nebraska.
Purpose: To compute the deflections at the tenth points of the span and at the pins of cantilevers for a statically determinate beam of variable section.
Method: Moment-area principles.
Limitations: Accurate to approximately $\frac{1}{100}$ in.
Input-Output: Input includes the span and moments of inertia, loading conditions, and moments. Output includes the deflections at the tenth points and at the pins.
Machine details: Programmed in basic machine language using approximately 1,500 locations. Running time about 30 sec.
Availability: Available only to tax-supported institutions from the State of Nebraska, Department of Roads, Computer Section, Lincoln, Nebr.

Program St. 42: Open conduits supported by an elastic foundation—structural
Equipment: Basic IBM 650.
Programmed by: U.S. Army Engineer District, Omaha, Nebr.
Purpose: To compute the statically indeterminate shears, moments, thrusts and foundation pressures necessary for the structural design of an open conduit supported by an elastic foundation and subject to various external and internal loads.
Method: The desired forces and moments are determined by the simultaneous solution of the slope-deflection equations for each member of the structure.
Limitations: The program is restricted to open conduits with vertical channel walls and uniform base thicknesses. The accuracy is to eight places. Floating point notation is used.
Input-output: The input data include all dimensions and design criteria required. The output data check the validity of the assumptions and report the statically indeterminate shears, moments, thrust and foundation pressures required.
Machine details: This program was written in the general purpose system I.2. Input requires 31 storage locations. Output requires from 12 to 41 locations. Running time is up to 15 min. per problem.
Availability: This abstract is included through the courtesy of the Corps of Engineers, with the understanding that the abstract itself is public property and not subject to copyright. The abstract is accordingly exempted from the general copyright notice applicable to this publication. Address inquiries: Department of the Army, Office of the Chief of Engineers, Engineer Data Processing Center, Washington 25, D.C.

Program St. 43: Gravity and semi-gravity-type walls—sliding and overturning stability
Equipment: Basic IBM 650.
Programmed by: U.S. Army Engineer District, Omaha, Nebr.
Purpose: To analyze the stability of gravity or semi-gravity-type retaining walls.
Method: The walls are designed in accordance with the Engineering Manual for Civil Works, Part CXXV, Chap. 2, Retaining Walls.
Limitations: This program is restricted to gravity and semi-gravity walls with a vertical face at toe side, and to loading conditions with no active earth pressure at toe side. No provision is made for earthquake loading. Accuracy is to eight places.
Input-output: Input data include all required dimensions and design criteria to calculate and determine the validity of the assumptions. Output data include ordinates of water and earth pressure diagrams; summations of weights, forces and moments; location of resultants at base; pressures at heel and toe; overturning factor of safety, sliding factors at bottom of concrete and minimum sliding planes within the foundation material.
Machine details: Programmed in general purpose systems, I.2 program; requires 350 drum locations. Running time approximately 25 sec. for each wall section.
Availability: Available as in St. 42 and under the same conditions.

Program St. 44: Retaining wall and abutment analysis program
Equipment: IBM 650.
Programmed by: Oregon State Highway Department.
Purpose: To analyze cantilever retaining walls and gravity walls for various pressures, moments, and shears required for the design.
Method: The vertical and horizontal loads acting on the walls and their moments about the heel are first determined. The resultant force and eccentricity about the center of gravity are next computed together with the overturning and resisting moment and the soil pressures at the heel and toe. Moments are computed at the fifth points along the stem; total shear is found at the bottom of the stem; and the bending moments and shears are determined at the heel and toe.
Limitations: (1) For pile-bearing walls output is limited to the bending moment and shear required for the design of the stem only, together with the quantities necessary for stability analysis; (2) the resultant of any passive earth pressure may not be located below the bottom of the footing.
Input-output: Input required includes the dimensions of the walls to be analyzed and the loads to be applied. Output includes the summation of all forces and moments; the location of the vertical force; and the moments and shears required for design purposes.
Machine details: Programmed in SOAP, using approximately 800 words. Not readily relocatable. Running time for a complete solution is about 1.8 sec.
Availability: Program deck and write-up available from: Processing Division, Oregon State Highway Department, Salem, Ore.

Program St. 45: Concrete column analysis
Equipment: IBM 650.
Programmed by: State of Nebraska.
Purpose: To compute the stresses in a laterally tied concrete

column subjected to axial or combined axial and bending loads in one or two directions.

Method: The trial-and-error solution is used to find the location and direction of the neutral axis (AASHO Specifications).

Limitations: Modular ratio equals 10. Concrete stress at 28 days equals 3,000 psi. Steel working stress equals 18,000 psi. Program is limited to rectangular concrete columns.

Input-output: Input includes the dimensions of the column cross section, the length of the column, the location of steel in the column, and the applied loads. Output includes the allowable axial loads or the allowable concrete stress, the maximum concrete stress, maximum tensile steel stress, and maximum compressive steel stress.

Machine details: Programmed in SOAP using approximately 1,000 locations. Running time is less than 1 minute.

Availability: Available as in St. 41 and under the same conditions.

Program St. 46: Box culvert analysis

Equipment: IBM 650.

Programmed by: State of Nebraska.

Purpose: To design the box section of a single span, rigid frame, concrete box culvert.

Method: Frame analysis done by moment distribution. AASHO Specifications and loadings used.

Limitations: Allowable concrete stress=1,200 psi in flexure; allowable concrete stress=90 psi in shear. Allowable steel stress equals 18,000 psi. Lateral earthload of 30 psf; vertical earthload of 84 psf.

Input-output: Input includes the span, rise, and fill over the box. Minimum thickness of slab and wall, number of traffic lanes and width of the graded roadway. Output includes the minimum design dimensions, size, and spacing of all reinforcing bars, concrete, and reinforcing steel quantities.

Machine details: Programmed in basic machine language, using the entire 2,000-word drum. Running time for complete solution is approximately 3 min. maximum.

Availability: Available as in St. 41 and under the same conditions.

Program St. 47: Retaining wall—sloping surcharge

Equipment: IBM 650.

Programmed by: Gannett, Fleming, Corddry & Carpenter, Inc., Harrisburg, Pa.

Purpose: To design the footing of a concrete retaining wall subjected to a sloping surcharge backfill.

Limitations: Wall must rest on spread footings and the surcharge must be sloping upward. Rankine's formula for earth pressure is used.

Input-output: Required input: Height of wall; stem dimensions; backfill height and slope; allowable stresses; backfill weight; steel clearances, stability, sliding and allowable soil pressure criteria. Output: Footing width, toe length, footing depth; area and perimeter of reinforcing steel; concrete stress; and the actual soil pressure; sliding factor; overturning factor and location or resultant.

Machine details: Programmed in the Bell Interpretive System. Requires approximately 8 min. to compute footings for three wall heights.

Availability: Available on an exchange basis from Gannett, Fleming, Corddry & Carpenter, Inc., Harrisburg, Pa.

Program St. 48: Beam deflection computation

Equipment: IBM 650.

Programmed by: Detroit Edison Company.

Purpose: To compute deflections of a simple span beam loaded with 1 to 42 concentrated loads.

Method: The conjugate method of analysis is used.

Limitations: A maximum of 42 concentrated loads.

Input-output: Input required is the moment at each load; distance between loads; moment of inertia at each load, or the dimensions of the section at each load. Output is the deflection.

Machine details: Programmed in basic machine language using 1,200 locations. Running time approximately 18 sec for one problem.

Availability: Available on a limited basis from The Detroit Edison Company, 2000 Second Avenue, Detroit 26, Mich. Attention: Mr. Lloyd W. Combe.

Program St. 49: Beam shear and moment computation

Equipment: IBM 650.

Programmed by: The Detroit Edison Company.

Purpose: To compute end reactions, shear, and moment under each load for a simple beam loaded with from 1 to 42 concentrated loads.

Method: Standard method of calculating shears and moments is used.

Limitations: A maximum of 42 concentrated loads.

Input-output: Input data consist of the span, the number of loads, the magnitude of each load, and the distance between loads. The output data are the end reactions, the shear, and the moment under each load. This information is used as input to the program on girder design.

Machine details: Programmed in basic machine language using 1,700 locations. Running time is a maximum of 30 sec.

Availability: Available as in St. 48.

Program St. 50: Beam constants for variable section members

Equipment: IBM 650 with additional features.

Programmed by: School of Civil Engineering, Oklahoma State University, Stillwater, Okla.

Purpose: To compute angular flexibilities, carry-over values, and to compute angular load functions due to dead load, uniform load, and concentrated load for beams with parabolic haunches.

Method: Numerical integration.

Limitations: This program is limited to beams with parabolic haunches. This haunch length must be expressed to the nearest tenth of the span length.

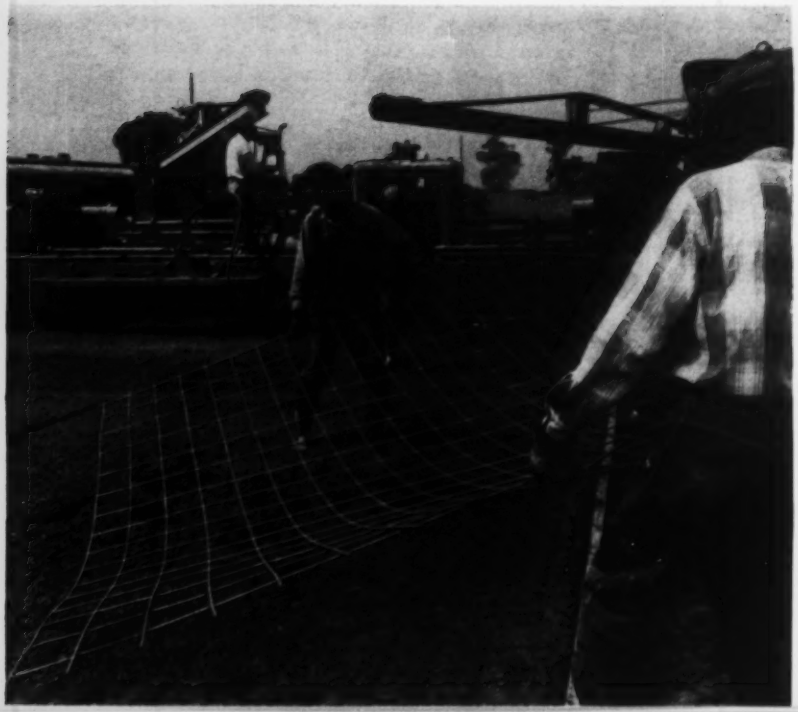
Input-output: The input contains: (1) Haunch depth parameter, (2) haunch length parameter, (3) beam identification (symmetrical—two haunches, unsymmetrical—one haunch). The output includes coefficients for determining: (1) angular flexibilities at both ends, (2) carry-over value, (3) angular load functions at both ends due to dead load, uniform load, and concentrated load.

Machine details: Programmed in SOAP, using floating decimal arithmetic. The additional features: High-speed storage, and indexing registers A, B, and C, are used.

Availability: This program is available in Research Publication No. 4 (Analysis of Continuous Beam Bridges, Vol. II), School of Civil Engineering, Oklahoma State University, Stillwater, Okla.

[*Editor's Note:* Through an error that is much regretted the titles of two programs listed in the March and May issues were interchanged. Program St. 18 (page 81, March) is, of course, for Rigid Frame Pier Analysis, and Program St. 19 (page 78, May) is for Riveted Plate Girder Design.]

Steel reinforced ...to stand up



PROJECT: Portion of Northwest Expressway just west of Cumberland Avenue Interchange, Cook County, Illinois

OWNER: Cook County Department of Highways

CONTRACTORS: Arcole Midwest Corp., Evanston, Illinois

WIRE FABRIC DISTRIBUTOR: E. W. Zimmerman, Inc., Chicago, Illinois

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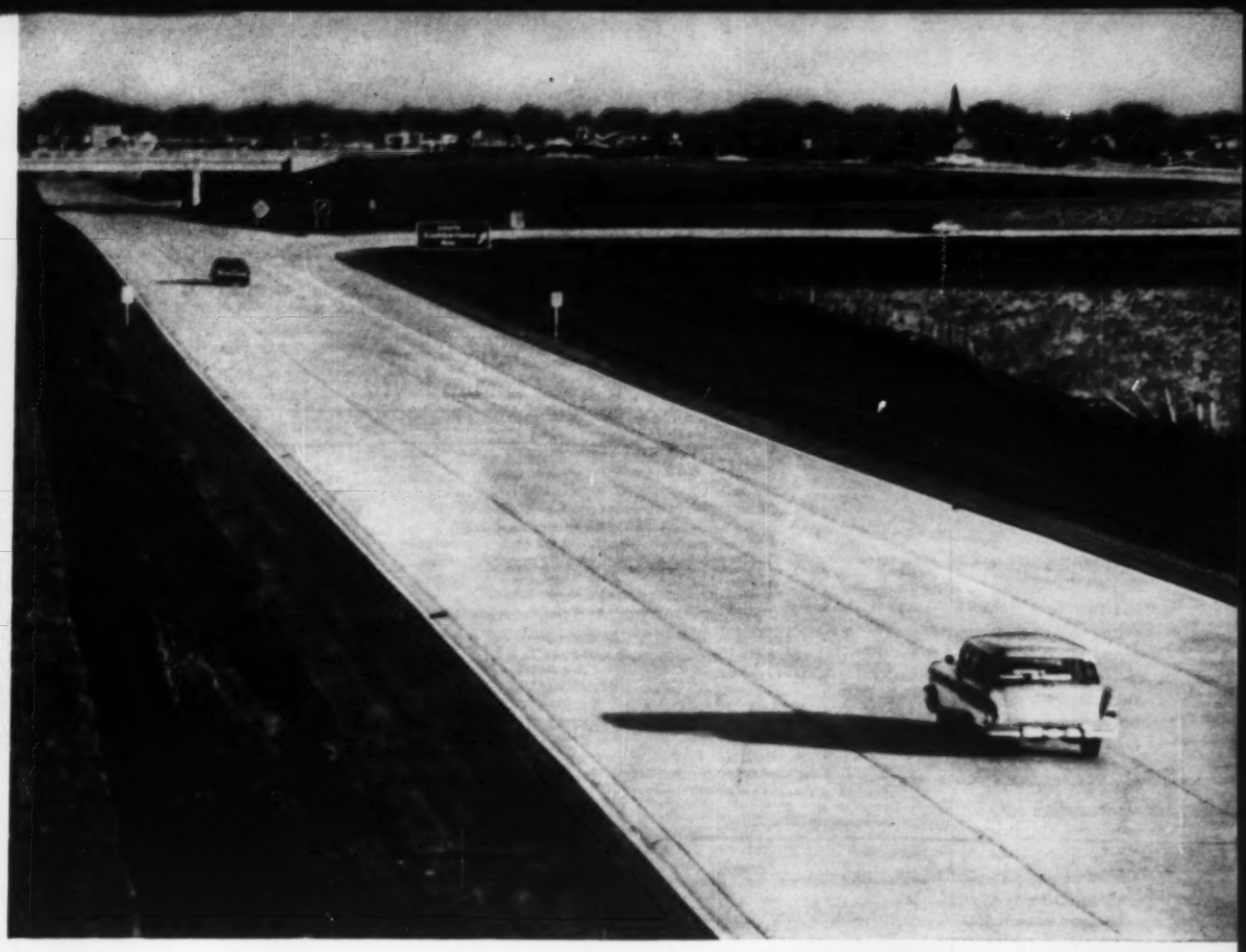
dependable Steel.



under the hi-speed pounding of modern traffic

Cook County, Illinois has opened the first section of its new Northwest Expressway. And, like other expressways built under the authority and supervision of that county's Department of Highways, it is steel reinforced.

An anticipated daily count of 31,000 vehicles is expected on this newly opened 4½-mile section which extends from Foster & Central Avenues to the Illinois Toll Highway. This figure indicates what this already busy strip will be subjected to as the traffic load gets heavier. And it points up the importance of building into all new roads and highways the strength it will take to stand up under the almost ceaseless pounding of modern hi-speed traffic in the years ahead.

Highways reinforced with steel have a balanced design in that all edges and corners are fully protected. USS American Welded Wire Fabric accomplishes distributed load transfer and reduces stresses about 30% which accounts for the truly superior performance of reinforced concrete over non-reinforced concrete. Reinforced pavements provide a safe, smooth riding surface that lasts.

USS American Welded Wire Fabric is today stronger than ever. Minimum tensile strength is now 75,000 psi and minimum yield point is now 60,000 psi. It has reserve strength for heavier pounding and it is available in a completely machine fabricated form, ready for immediate placement. For more information, write to American Steel & Wire, 614 Superior Avenue, N. W., Cleveland 13, Ohio. *USS and American are registered trademarks*

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The Younger Viewpoint

Committee on Younger Member Publications

Walter D. Linzing, Chairman; 4751 No. Paulina, Chicago 40, Ill.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko 289 Foxhill Road Denville, N. J.	Albert C. Nelson 250 N.E. 51st Street Miami, Fla.	William R. Walker 4600 Franklin Ave. Western Springs, Ill.	Judd Hull 6000 S. Boyle Ave. Vernon, Calif.

Walter D. Linzing, chairman of the Committee on Younger Member Publications, is this month's editor.

Accelerated interest in professionalism

Recent letters and expressions of opinion in "The Younger Viewpoint" have prompted a gratifying series of replies from our readers. It is especially noteworthy that engineers are taking the time to read, consider, and try to solve professional problems that civil engineers face in their careers. Some of the solutions have been given in detail. Letters have not been dashed off in a moment of emotionalism without an analysis of the situation. On the contrary, most letters are in the nature of constructive criticism with suggestions for alleviating specific situations.

The "Younger Viewpoint is not looking specifically" for "gripes" per se. Anyone can "gripe" about something in magnificent heights of prose, but it requires creative imagination to suggest remedies and changes. Our correspondents have shown a real interest in the Society and the profession. The leaders and administrators of ASCE may well consider some of the suggestions that are being advanced in "The Younger Viewpoint." Unfortunately, space is limited, and several of the letters received this month have been quite long. We hope that their context has not been seriously impaired by editing them to fit. May we suggest that readers try to limit their letters to one or two pages?

Suggests ASCE publish employment guide

"To 'The Younger Viewpoint':

"I read the letter from Mr. Walsh, published in the May issue, and feel I can add to the discussion of graduate recruiting on the basis of personal experience.

"I received my B. S. in civil engineering in June 1958 and my M. S. in June 1959. In my studies for both degrees I ranked high in the class and received several academic honors. During the spring of 1959 I was interviewed by over a dozen firms, most of them not primarily civil engineering firms but organizations using civil engineers for plant construction or for related fields such as aircraft. In addition, I corresponded with several of the large construction firms. Only one offer came from a civil engineering firm. The other offers were from the large companies utilizing civil engineers in related capacities. I accepted the offer of an aircraft firm for several reasons, the primary reason being geographical location.

"Several months ago I felt I would like to return to civil engineering as I had envisioned it—the design or construction of structures and facilities. I made use of the Professional Services Index of CIVIL ENGINEERING. I personally visited over half a dozen of the largest and best know consulting firms in New York City. The result was generally the same. I was told there is just enough work to maintain the present staff. No new help is needed. Correspondence with other firms has yielded no better results. The technique of going to a firm without knowing whether you are wanted or not works well in times when jobs are more plentiful but in leaner times such as these there is a limit as to how many inquiries you can make before receiving the impression something is wrong in the field.

"Two years ago The Moles held a series of meetings for undergraduate civil engineers, trying to encourage them to enter the construction field. During these meetings the question always arose, 'Which firm wants us?' The answer, 'Consult the trade publications to see which firms have work and go from one to the other.' Why did The Moles go to all this trouble and expense to tell us something most of us already knew?

"We have worked as hard to complete our education as have engineers in other fields yet we must search out the job we want or even resort to an agency. The Society is quite eager to encourage students to enter the profession but does not follow through. Perhaps a guide to firms seriously interested in hiring young engineers could be issued periodically. This would leave a good deal of the hunting up to the individual's own initiative yet would assure him that his application is not just a waste of effort. The profession would also appear in a better light, since talk of a lack of new opportunity casts doubt on the growth potential of such a field. I do believe the Society should participate more actively in guiding those just entering the civil engineering world.

"Harvey A. Kagan, A.M.ASCE
New York, N. Y."

More encouragement from members urged

"To 'The Younger Viewpoint':

"Regarding questions recently proposed in 'The Younger Viewpoint' and the failure to interest the Associate Member group in the Society, I do not qualify in the Younger Member group, but would like to express my opinions.

"Even though ASCE does more to promote student activity from the national level than any other society and more graduates join ASCE than any other society, I believe that the basic fault lies in the Society Local Sections and the members themselves. The ASCE headquarters is doing all it can, and the faculty tries.

"However, I have attended Section and national meetings where the primary interest of the senior members attending seemed to be social—meeting old friends, business deals, etc. They seemed to have little time for any student or student programs that might be present or presented. Sort of a 'nice to have you, but don't bother me' attitude.

"In many cases, students were separated completely as to activity, even segregated on a membership attendance list, often tacked onto the tail of a meeting when most others were starting home and, in general, disposed of where they would create as little interference as possible. Usually they were granted reduced prices and encouraged to attend all activities, but they would come back from such a meeting wondering why they bothered to go at all, and why join such an organization.

"We in the colleges, encourage all possible connections with the Society, encourage registration, but our efforts seem to be in vain after some meetings we attend.

"I imagine this is true to varying degree in different parts of the country. In talking to other Faculty Advisers, I find that some get little or no help from their Contact Members and their Branch or Section. I am not attempting to single out any Section or any Section meeting for specific criticism, but am directing it at all Sections in general.

"Luckily for us, I could wish for no better relationship than exists between us and the El Paso Branch of the Texas Section.

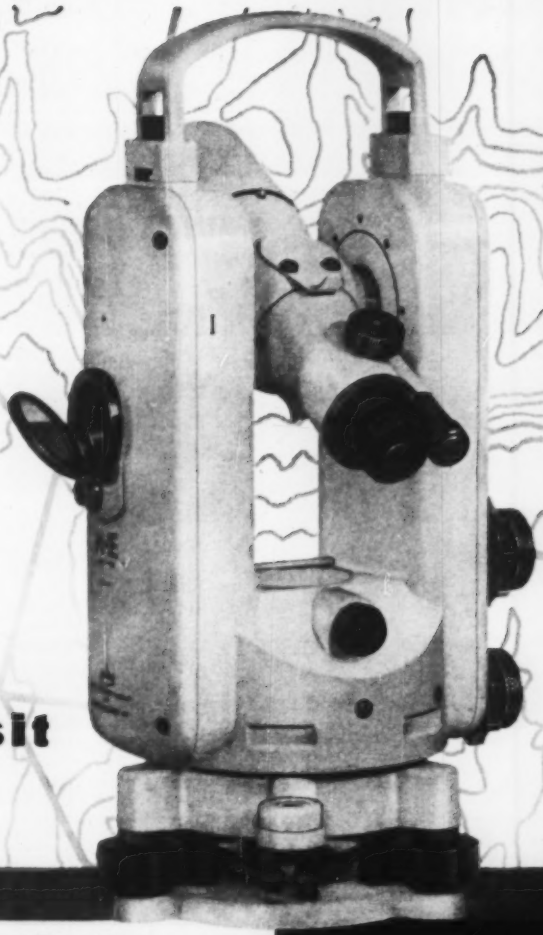
"I do not think the solution lies in the member once he has become an Associate Member, but must go farther back, to when he was a student. Show him that he is wanted, that he is a valuable member, correct some of the situations mentioned previously, and I believe we will have eager Associate Members and active ones.

"The civil engineering student—and he is decreasing in numbers, whether he is at present in school or coming up in the future—represents the future of the Society. If he does not want it, does not believe in it, he will not care a hoot about what happens to it.

"Paul C. Hassler
Faculty Adviser, Student Chapter
Texas Western College of the
University of Texas, El Paso, Tex."

Philosophy, professionalism and the engineer

Among other interesting letters received is one dealing with a philosophic derivation of a new title for engineers, employing the logic of Plato, and a commentary on the "What's in it for me?" answer to a question on professionalism and the engineer. Look for these and other interesting items in future columns of "The Younger Viewpoint."



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Cleveland builds new piers to win Seaway traffic... Designing with USS Steel Sheet Piling saves time and money

Ready for Seaway Traffic. Cleveland's new West 6th Street Pier built in fast time with 2,252 tons of USS Steel Sheet Piling.

Great Lakes cities are competing with each other to build facilities to attract and service St. Lawrence Seaway traffic. The City of Cleveland was one of the first to start, and built the new West 3rd Street Pier and West 6th Street Pier to meet Seaway specification depths of 27 feet alongside. The West 3rd Street Pier is 710 feet long and 509 feet wide and has an area of 4.1 acres. The West 6th Street Pier is 697 feet long, 297 feet wide and has an area of 4.65 acres. Both piers are constructed of USS Steel Sheet Piling which is utilized to enclose the developed area. These piers may well be the forerunners of many similar structures being considered for Great Lakes ports.

The West 6th Street Pier is the newest of the two, having been only recently completed. For this job the engineers considered various types of structures but finally selected an anchored steel sheet pile bulkhead to enclose the area to be developed. Comparative bids proved this to be the most economical type of pier. What's more, it could be built quickly.

For maximum beam strength, Z-type steel sheet piling was chosen. The general contractor, Merritt-Chapman & Scott Corporation, Cleveland, Ohio, wanted quick deliveries and service . . . so they ordered USS Steel Sheet Piling. They used 2,252 tons of Z piles in 60-foot and 70-foot lengths. The steel sheet piling was driven to 33 feet of penetration beyond the 27-foot dredged depth. Side walls of the pier are retained with double channel wales and 3-inch diameter tie rod assemblies extending across the full width of the pier. The front wall is anchored with wales and the tie rods to batter pile assemblies incorporating concrete filled pipe piles. A novel fender system protects the pier in which cored rubber inserts furnish required resilience.

Theoretical assumptions relative to horizontal pressures on earth retaining structures are still undergoing investigation by scientists. In order to assist in the development of more accurate knowledge of this subject, permanent strain gauges were installed at critical points in the piling.

The design of these structures was under the direction of W. J. Rogers, Director of Port Control, and J. H. Rowland, Commissioner of Harbors, City of Cleveland. The Osborn Engineering Co. of Cleveland were Consulting Engineers.

When you need any type of steel piling, steel sheet piling, H-piles, or pipe piles, call the nearest United States Steel office, or contact United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

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Air view of the 202,257-square-foot West 6th Street Pier and to the left the 177,800-square-foot West 3rd Street Pier. Both piers constructed by Merritt-Chapman & Scott.

USS Z Piling offers strength and economy in building piers and bulkheads.

Three Members Admonished for Unprofessional Conduct

As a result of careful investigations by the Committee on Professional Conduct, the Board of Direction acted on June 20 to caution three members for conduct held to be questionable under the Code of Ethics.

Two of the cases involved the participation of members in public meetings in connection with proposed engineering projects. The principals in these separate incidents were reminded that the entire profession is subjected to unfavorable public attention when an individual resorts to extremes in his statements and actions in a controversial situation.

The third case related to a competitive bidding problem, in which there were extenuating circumstances by reason of the conditions under which the principal was invited to quote his fee. He was advised to exercise the greatest care in future situations of this kind, to make sure in so far as possible that there is no intention on the part of the client to compare his fee quotation with that of another engineer.

Considerable concern was manifested, both by the Committee and the Board, in the growing use of display space in advertising professional engineering services, often in connection with construction and management. This area of activity is being subjected to continuing study with a view toward establishment of a firm policy and guide lines that will be applicable throughout the profession.

Karl Terzaghi Award Established by ASCE

ASCE will announce the establishment of the Karl Terzaghi Award at a luncheon meeting to be held on Tuesday, October 11, during the Boston Convention of the Society. This award, which is sponsored by the Soil Mechanics and Foundation Division, will honor Prof. Karl Terzaghi, Honorary Member of the Society, three times winner of the Norman Medal, and the father of modern soil mechanics. The award, which is expected to become one of the premier awards of the Society, will be given for outstanding contributions to soil mechanics and foundation engineering appearing in any of the Society's publications. It will be given at intervals of approximately three years and will be accompanied by an honorarium of $1,500. Neither Society membership nor U. S. citizenship is a prerequisite for receiving the award.

At the luncheon meeting of the Society on October 11, Dr. Jorj Osterberg, chairman of the Executive Committee of the Soil Mechanics and Foundations Division, will deliver funds collected by the Award Committee to President Marston, who will declare that the award is formally established and that all papers in any ASCE publication will be considered for it. Dr. Terzaghi is expected to make a brief acknowledgment and to state his views about the award.

The award is being established by contributions from members of the Society and other friends and admirers of Dr. Terzaghi. Contributions have been received from many foreign countries, including Canada and Mexico. The Soil Mechanics and Foundations Division appointed a Terzaghi Award Committee to invite contributions from engineers and engineering and contracting firms towards a principal sum that will establish the award in perpetuity.

All engineers and firms interested in hearing about the award are invited to contact the Committee Chairman, Stanley J. Johnson, c/o Moran, Proctor, Mueser & Rutledge, 415 Madison Avenue, New York 17, N. Y.

Aid Asked in Reviewing Manual of Practice

A proposed Manual of Engineering Practice has been prepared by the Committee on Structural Dynamics of the Engineering Mechanics Division for review preceding publication by the Society. The Manual was written for the use of the engineering profession in the design of structures which are intended to be resistant in some degree to all the effects associated with the detonation of a nuclear weapon.

Before the Manual is approved for publication the Board of Direction will appreciate having the critical comments of the Society's membership. The comments will be used in preparation of the final manuscript.

A limited number of copies of the proposed Manual are available for review on a loan basis on request to the Executive Secretary. The copies may be kept for two weeks. Comments must be mailed to Society headquarters before October 15.

Interesting Young People In Civil Engineering

To give young people an insight into civil engineering, with the idea of attracting some of them into the profession, Lockwood, Kessler & Bartlett, Inc., Syosset, N. Y., has undertaken a commendable introductory program for junior high school pupils. First to visit the firm's office were 28 top-ranking ninth graders from the Great Neck, N. Y., Junior High School, who spent a day there. Said Ford Bartlett, F. ASCE, president of the firm, "We were amazed and gratified at the interest and intelligence of these youngsters. . . . If these boys and girls are any criterion, there is no lack of talent. Our problem is to find and develop the potential. What better start is there than to expose young people to the excitement of engineering?"

Lockwood, Kessler & Bartlett are pioneers in photogrammetry and in the construction of precise contour maps from aerial photographs. More recently they have been adapting electronic computers to map making.

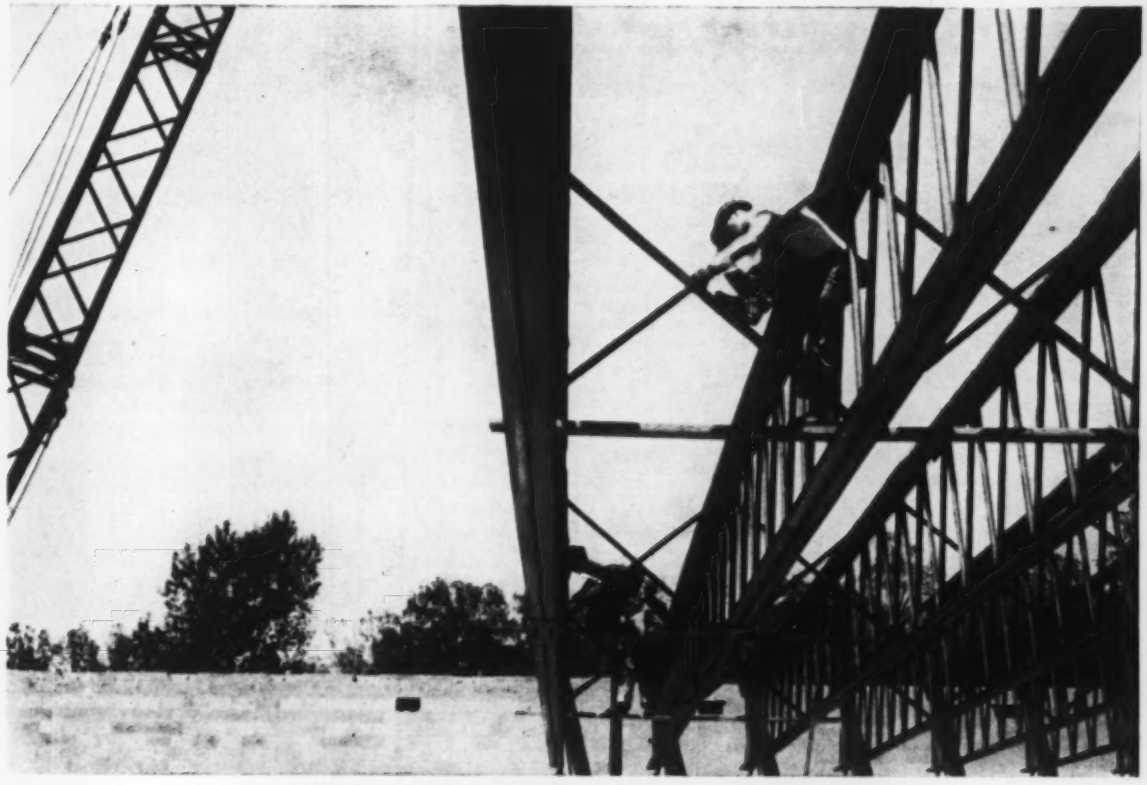
Correction—Desalization Costs

In the Reno Convention story in the August issue (page 59), Samuel B. Morris, author of a paper on economic aspects of water desalization, is misquoted. As a result of two misplaced dollar signs Mr. Morris is quoted as saying that the price of irrigation water at the farmer's headgate is from $.30 to $3.07 per thousand gallons. What Mr. Morris said, of course, was that the price is from 0.307 cents to 3.07 cents per thousand gallons.

ASCE Membership as of August 9, 1960

Fellows	11,151
Members	16,179
Associate Members	18,681
Affiliates	102
Honorary Members	47
Total	46,160
(August 9, 1959	43,447)

TOTAL PRODUCT SATISFACTION



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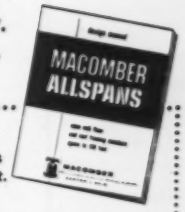

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NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

ASCE CONVENTIONS

ANNUAL CONVENTION

Boston, Mass.
Hotel Statler
October 10-14, 1960

PHOENIX CONVENTION

Phoenix, Ariz.
Hotel Westward Ho
April 10-14, 1961

ANNUAL CONVENTION

New York, N. Y.
Hotel Statler
October 16-20, 1961

LOCAL SECTION MEETINGS

Kansas City—Annual Power Conference at the Continental Hotel, Kansas City, Mo., November 10 and 11.

Metropolitan—Regular monthly meetings in the Engineering Societies Building on the third Wednesday of each month, at 7:00 p.m. New season starts in October.

Philadelphia—Regular monthly meeting at the Engineers' Club on October 11.

Sacramento—Weekly meetings at the Elks Temple every Tuesday, at 12 noon.

Tennessee Valley—Fall meeting at the Hotel Patten, Chattanooga, November 5 and 6.

John M. Kyle (upper photo, left) chief engineer of the Port of New York Authority, receives the Metropolitan Section's Metropolitan Engineer of the Year Award from the retiring president of the Section, Michael Salgo. An account of the meeting appeared in the July issue.

John F. Laboon (upper photo, right) executive director and chief engineer of the Allegheny County Sanitary Authority, was hailed by the Pittsburgh Section as "Engineer of the Year" at a testimonial dinner given in recognition of his "unusual, novel and outstanding engineering achievements." Here he receives his certificate of award from Michael A. Gross, president of the Section. Mr. Laboon was guiding light of Pittsburgh's famous new $100 million sewage disposal plant, which won Honorable Mention in the recent Outstanding Civil Engineering Achievement Competition (June issue, page 45).

District 16 Sections Form ASCE Council

The Society's Board of Direction took action at the recent Reno Convention to give formal approval to organization of the District 16 Council, which is composed of the Colorado, Iowa, Kansas, Kansas City, Nebraska, and Wyoming Sections. The first official meeting of the District 16 Council Board was held at Omaha, Nebr., on April 29. At this meeting N. T. Veatch, ASCE Director for District 16, reported that all the Sections in District 16 had adopted the proposed constitutions and by-laws. Forthcoming ASCE elections, proposed changes in District and Zone boundaries, financial and membership problems were discussed at the all-day meeting. It was apparent to all who attended that a much closer relationship is now possible between the executive committees of the respective Sections and that better solutions for mutual Section problems can be obtained.

Established primarily for the purpose of consolidating District 16 opinion and furthering cooperative action on Society affairs and related professional affairs of common interest to the membership of the Sections, the organization joins other District Councils in furthering ASCE aims and services.

The District 16 Council Board consists of the following delegates: William R. Gibbs (Kansas City Section), chairman; Elwood R. Leeson (Kansas Section), vice chairman; Merwin D. Dougal (Iowa Section), secretary-treasurer; W. A. Clevenger (Colorado Section); Nathaniel W. Beezley (Nebraska Section); and John S. Bereman (Wyoming Section).

Civil engineers at Ft. Belvoir, Va., recently were host to the National Capital Section at a Saturday morning inspection and luncheon. Gen. Gerald E. Galloway, F.ASCE, in front row center, is commanding general at the base, while Col. William A. Sundlof, M.ASCE, front row left, arranged the fine program. The Mechanical and Technical Division put on a show of the construction equipment used to train army engineer troops, followed by an inspection of the Division's various special activities.

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The Gatwick application is but one of many in which the know-how of top designers, working with prestressed concrete, is shaping the future of building the world over. Industrial plants, bridges, warehouses, schools, stores, banks, piers . . . whatever *your* application, you can keep pace with advances in prestressed concrete technology without cost or obligation. Just fill out and mail the coupon.

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BY-LINE WASHINGTON

A Corps of Engineers report on **inland waterways** sent to the Senate Select Committee on Water Resources this month (September) is one of the most powerful arguments ever presented as to the value of the nation's 140-year investment of $2.8 billion in its waterways. Key point: The average annual increase in waterways freight tonnage over the past 11 years—7.8 billion ton-miles—is the equivalent of adding a new transcontinental railroad, 2,600 miles long, to the nation's system each year. Railroads as they now exist could not even absorb the annual increase—much less the basic tonnage—without huge additional investments. The report suggests the U.S. might spend another $7.9 billion on waterways to enable them to handle increases to the year 2000.

Indicative of the strength of the construction market developed by **inland waterways** is the result of a second-quarter survey of new industrial plant facilities, completed by the American Waterways Operators, Inc. The survey shows 56 new industrial plants to be serviced from the waterways were either under construction or planned in the second quarter of 1960. That brings the total of such installations built or planned since 1952 to 3,320, according to the AWO. Some 43 percent of these were for the chemical, petrochemical, and petroleum industries.

* * *

Can you force a city to spend money for **pollution abatement**—after taxpayers have voted down a proposed bond issue to finance such a program? It's a question of interest both to engineers and legal experts, in view of the request of the Department of Health, Education & Welfare that the Department of Justice bring such action against the **City of St. Joseph, Mo.** Since the suit would be the first under the Federal Water Pollution Control Act, it would be a test case. The background is that a year ago HEW ordered St. Joseph to end dumping raw sewage into the Missouri River and set a timetable calling for a bond election this year, with construction of a disposal plant completed by 1963. But voters flatly rejected the bond issue proposal, thus blocking further city action. Some lawyers in Washington suggest that the only answer may be injunctions against each of the city's 78,000-odd residents.

* * *

Photogrammetrists have decided to "go professional" immediately—that is, to follow the lead provided by ASCE and **refuse to bid competitively for photogrammetric work.** A policy to this effect has been adopted by the Association of Professional Photogrammetrists (which has headquarters in Washington), and members are urged to seek to meet licensing requirements. The APP action follows ASCE re-affirmation of its position that certain aspects of surveying (including photogrammetric mapping) are professional engineering activities.

* * *

Establishment of a new **Corps of Engineers Ballistic Missile Construction Office** (CEBMCO) at Los Angeles is both an answer by the Corps to criticisms of alleged lags in missile base construction, and a major change in the operating policies of the Corps. Brig. Gen. Alvin C. Welling, commanding CEBMCO, has direct access to the Chief's office, direct authority over all ballistic base construction—cutting out traditional Division and District office authority—will let all future contracts, handle all supervision of construction operations, and can authorize changes directly. General Welling will also be responsible for experimental construction at Vandenberg AFB. The initial staff is set at 175 officers and civilians, but there's talk in Washington of an eventual staff of as many as 2,000.

On the subject of that criticism, it can be revealed that Air Force behind-the-scenes comment was very bitter, and even included the strong suggestion that the Navy Civil Engineer Corps ought to be brought in to speed base construction. The Corps of Engineers, however, argues that thus far there has been only one instance of actual delay in the program, but says the cause of most trouble is the fact that it does not have control of design, as well as construction, and the concept of "concurrency"—building the bases while the missile itself is being designed—which occasions many construction changes.

* * *

No civil engineers are included in the ten-man membership of a **Federal Urban Renewal Council,** formed by the Urban Renewal Administration, even though the council is to "consider the fact that urban renewal is already beginning to embrace more . . . of the broad concept of community development . . . a really effective system of mass transportation, comprehensive planning, middle income and mass housing . . ." David M. Walker, URA administrator, assembled a group of bankers, city officials, educators, but said "further appointments" might be made.

* * *

Allocation of the full $2.2 billion authorized for **Interstate Highway** work in the fiscal year 1962 (plus $693.8 million for primary, secondary and urban, or ABC work) promises a measure of stability for highway work for the next several years, after the hiatus that occurred while the Highway Trust Fund was recovering from the effects of a Congressional addition of $1 billion to highway spending in 1958. Coming so soon after the recent announcement of allocation of a reduced $1.8 billion for fiscal 1961, it gives state officials, engineers, and contractors a solid base for figuring business. (Although $925 million is authorized for ABC work, apportionment depends partly on population, so the Bureau of Public Roads is holding back about $239 million, pending completion of census reports.)

* * *

Worried over what it calls a nationwide shortage of **radiological health specialists,** the U.S. Public Health Service held a three-day meeting in August at Princeton, N.J., to explore methods of reducing the shortage. Some 100 representatives of universities, professional societies and government services attended. Rapid expansion of the use of atomic energy and other radiation sources in the healing arts and in industry are causes for the shortage, said PHS. Schools of engineering, medicine and public health must aid the program, it was concluded.

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News Briefs . . .

Manpower Shortage Studied at ASEE Annual Meeting

A record 3,000 engineering educators and their families attended the 68th annual meeting of the American Society for Engineering Education, held at Purdue University the last week in June. This year's conference is said to have set new records for attendance as well as for scope and importance of discussion, which was devoted to the problems of engineering in this period of shortage of trained manpower.

The engineering educators were told that the much publicized shortage of engineers and scientists is actually "an acute shortage of qualified technicians in engineering and science." According to G. Ross Henninger, president of the Ohio College of Applied Science, who addressed the opening session, "The time already is past for a major modification of our traditional national concepts of what constitutes an adequate educational pattern, and in our traditional concepts of what constitues a balanced utilization of manpower."

Reporting on a three-year ASEE study of technical institute education, President Henninger said, "An appalling proportion of graduates in engineering and science continue to be occupied with work which has evolved out of engineering science into engineering technology."

Dr. Theodore von Karman, Hon. M. ASCE, chairman of the Advisory Group for Aeronautical Research and Development for NATO, told the meeting that schooling for engineers must include more material but that it must take no more time. That, Dr. von Karman said, is the only way for engineers to stop the loss of bright young minds to study in strictly scientific areas. The purpose of the engineer, he pointed out, is to create "not only ideas, not only theories, but also bridges, machines, airplanes—that we in the aeronautical industry call hardware."

In one of the major addresses of the week, Dr. Carl W. Borgmann, of the Ford Foundation, emphasized the responsibility of the engineer in helping to solve some of mankind's major social problems.

"If all mankind is to achieve even a small margin of gain above bare subsistence, then one of man's principal efforts will have to be to find the means to make and distribute this gain," he said. "We can expect that the creative technology of the modern industrial world will continue to increase that world's *own* material wealth. But if man as a race is to survive, this industrialized fraction of the world will have to share its knowledge, and . . . take the responsibility of discovering new knowledge. It is readily apparent that man has not even begun to solve his future engineering problems."

If the nation's mounting requirements for engineers are to be met, substantially increased numbers of engineering teachers must be found in the next decade. At present there is "relatively little activity" in American engineering schools to recruit and develop new teachers, according to Harold A. Foecke, of Notre Dame University. Professor Foecke's report summarized a three-year study of engineering faculties made by an ASEE committee under Ford Foundation and National Science Foundation grants.

The ASEE estimates that by 1967 American engineering colleges will need 7,000 more engineering teachers. Their salaries should average $12,500 in 1967, 105 percent more than today's average. This means a total salary bill of about $200 million, more than 200 percent over today's average, according to Dean Harold L. Hazen, of the Massachusetts Institute of Technology, chairman of the ASEE committee.

During the meeting Dr. Von Karman, famed California Institute of Technology aerodynamicist, received the organization's Lamme Medal for "distinguished contributions to engineering education and research."

Dr. Eric A. Walker, president of the Pennsylvania State University, is the new president of the ASEE. The newly elected vice presidents are Dean Melvin R. Lohmann, of Oklahoma State University, and Prof. Newman A. Hall, of Yale University. The other officers are W. Leighton Collins, F.ASCE, secretary, and Wendel W. Burton, treasurer.

Israel Develops New Port and City

The Israeli Government is developing a new port and city at Ashod, 65 miles south of Haifa. A master plan for port development, prepared by Frederic R. Harris, Inc., of New York, calls for a first phase of 16 ship berths and ultimate enlargement to 30 berths. Breakwater protection will be required as the new harbor is on the open sea. The main breakwater will have a length of 7,500 ft and a maximum depth of 50 ft; a supplemental breakwater will be 3,000 ft long. Rock will form the core of the breakwater with tetrapods up to 40 tons in weight serving as armor. It is expected that the harbor will be ready for shipping citrus fruit by October 1963.

Bridge Over Lake Maracaibo

The government of Venezuela is constructing a 5.5-mile bridge over Lake Maracaibo at an estimated cost of $80 million. The reinforced concrete structure, which will span the lake at a point 5 miles south of the port of Maracaibo, will have two 24-ft-wide lanes for motor vehicles separated by a 4-ft-wide central strip. Sidewalks 3 ft wide will run along both lanes.

Five spans in the middle of the channel, each 771 ft wide, will allow the largest tankers afloat to navigate under the bridge. At this point the height from the surface of the water to the roadway will be 165 ft.

Completion of the bridge is scheduled for 1962.

New WRI Building Design Handbook

A Building Design Handbook has been published by the wire reinforcement industry through its national trade association, the Wire Reinforcement Institute, Washington, D. C. The book is intended for use by designers, engineers, architects, consultants, and others concerned with reinforced concrete construction.

The new 168-page handbook is divided into two parts. The first consists essentially of general text and pictures describing the ways in which steel wire fabric is put to effective use. Tables, sketches, and detail drawings with case histories are included to help the design engineer and his draftsmen.

The second part of the design handbook deals primarily with the rapidly widening use of heavy (up to ½-in. dia.) welded wire fabric. It is principally a series of design tables with illustrative problems and is expected to be a working tool in the actual design of structures.

Self-Luminous Signs Suggested for Highways

The use of self-luminous signs employing isotope-activated phosphors has become commonplace in industrial plants during the past few years and is now finding increasing favor in aircraft, on instrument panels, and in the cabins. Application of the same principle to highway signs with development to increase the magnitude of visibility from a few feet to a range between 1,500 and 2,000 ft, is entirely feasible, according to the Bureau of Public Roads.

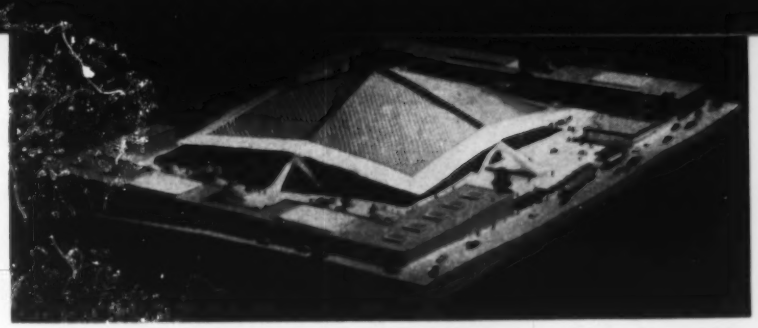
Self-luminosity may be accomplished satisfactorily, either with a special paint that can be used in the same manner as ordinary paint, or by incorporating the luminescence in plastic letters affixed to the customary sign material.

The original cost of the nuclear sign, even one using plastic letters, would be no more and would probably be less than for a comparable electrically lighted sign, which must have all the paraphernalia necessary to mount globes and bring the power to them.

Adequate radiation shielding, to comply with Atomic Energy Commission regulations as protection to personnel having occasion to be around the sign, and to the public, is no problem. Maintenance of the self-luminous sign would be less costly than a comparable electrically lighted sign.

No research is necessary, and the development work remaining to be accomplished is primarily that of increasing the magnitude of the luminescence now used in smaller nuclear-energized self-luminous signs, to the extent necessary to meet highway requirements.

Our thanks for this information to the Nuclear Energy Branch, Division of Operations of the Bureau of Public Roads.



Coliseum Century 21, major theme structure of Seattle's 1962 Exposition, will have one of the largest aluminum roofs ever built, formed of four hyperbolic-paraboloids. It is shown here in artist's sketch.

Aluminum Roof for Seattle Coliseum

One of the largest and most spectacular aluminum roofs ever built will sweep over more than three acres of Coliseum Century 21, the $4,000,000 major theme structure for Seattle's Century 21 Exposition, to be held in 1962.

The massive Coliseum roof will be formed of four hyperbolic-paraboloids. These four roof sections will be suspended from a "net" of cables fastened to concrete edge beams and steel trusses. The entire roof structure, in turn, will rest mainly on four huge tripods of reinforced concrete. The roof will rise to a center peak, which will be 110 ft (approximately 11 stories) above the floor.

More than 39,000 aluminum sandwich panels (4 x 8 ft) and 120,000 lb of extrusions will be used. The extrusions will form a grid into which the panels will be fitted. The aluminum sandwich panels are designed to offer acoustical control, insulation and structural strength.

Paul Thiry, of Seattle, is architect for the Coliseum; Peter Hostmark and Associates, the structural engineers; and the Howard S. Wright Construction Co., of Seattle, the general contracor. The aluminum roof will be fabricated by the Reynolds Metals Co.

Hydraulic Duet Raises Roof

Two "organists," playing a hydraulic duet on a construction job in Newark, N. J., are raising themselves and 190-ft-long slabs of concrete 40 ft into the air. The slabs, eleven in all and weighing about 270 tons apiece, will form the roof and upper floors of the Prudential Insurance Company's 500-car public garage, now under construction.

The workmen, who operate a pair of electric consoles with a keyboard of gauges and control valves, ride atop the slabs and actuate hydraulic jacks that raise them into position. All eleven slabs are warped to some degree, to form the automobile ramps of the garage. This is the first time warped slabs have been lifted. The sensitivity of control—to a tenth of an inch—permits them to be lifted at the exact angle at which they were poured.

Prudential is building the garage, situated on Plane St., between Bank and Academy Sts., to help alleviate Newark's downtown parking problem. Voorhees Walker, Smith, Smith & Haines, are the architects, and Gage and Martinson the engineers. The contractor was the Frank Briscoe Co., and the subcontractor the Lift-Slab Corp., of New York.

World's Largest Plate Stretcher Installed

This 30,000,000-lb plate stretcher has been installed by the Kaiser Aluminum Chemical Corporation at its Ravenswood, W. Va., plant. The largest machine of its type in the world, it is capable of stretching aluminum plate up to 6 in. thick and 160 in. wide, and can handle material with a maximum cross section of 640 sq in. Components of the stretcher were produced by Hydraulik of Duisburg, Germany. Two castings, each weighing 132 tons, were the important pieces to form each of the stretcher heads with the two units mounted on very accurately placed railway track. Forged steel working columns 42 in. in diameter and 35 ft long on each side of the machine control the movement of the heads. The stretcher is mounted on a rectangular reinforced concrete foundation on gravelly sand compacted to 95 percent of optimum density. Design of the stretcher was performed by Kaiser Aluminum's Advanced Engineering Design Division under the direction of A. Dean Smith. Field supervision was headed by R. C. Wilson and construction done by the Henry J. Kaiser Construction Co.

July Construction Spending Below Last Year's Level

The value of new construction put in place in July amounted to $5.2 billion, according to preliminary estimates of the Bureau of the Census of the U. S. Department of Commerce. Although this amount was 3 percent above the June 1960 level—approximately the normal increase between June and July—it was 4 percent below the July 1959 level. Both private and public spending for construction this July were above the June level but down from last July—private construction by 3 percent and public construction by 6 percent.

Cumulative expenditures for the first seven months of 1960 amounted to $30.4 billion, which was 2 percent below the $31.2 billion expended in the first seven months of 1959.

The physical volume of construction in the first seven months of 1960 was also down from last year. Measured in terms of the seasonally adjusted annual rate in constant 1947-1949 dollars, the physical volume of construction declined 6 percent. The physical volume of private construction in July 1960 was 5 percent less than in July 1959 and, in the same period, total public construction declined by 7 percent.

A-36 Specification Available

Recent adoption by the American Society for Testing Materials of a new specification for structural steel (ASTM Specification A-36) is recognized by the American Institute of Steel Construction in a supplement to the current AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. This supplement is intended to serve until the specification is revised to incorporate numerous advancements made possible through recent intensive research.

It is expected that the complete revision will be available within a year's time. Among other things, it will provide for use of various grades of high strength steel in addition to these provisions for the new A-36 steel. The supplement on A-36 steel is available without cost from the American Institute of Steel Construction, 101 Park Ave., New York 17, N. Y.

Storage City Built Under The Gulf of Mexico

The world's first underwater "storage city" recently became a reality. Anchored 300 ft off St. Petersburg Beach, in 35 ft of Gulf of Mexico waters, the new storage facility will be used by St. Petersburg to cache emergency supplies of water, fuel, medicines and food in the event of an enemy attack or a natural catastrophe.

Two 10,000-gal tanks, forerunner of million-gallon containers to be constructed in the immediate future, were lowered into the Gulf of Mexico to rest on specially designed concrete cradles. Safely below the water, these tanks will store liquids, fuel food and medical supplies for the community in the event of a tornado, hurricane, nuclear attack or other disaster that could wipe out above-land supplies. The below-water supplies can be pumped to shore-based points on land in less than an hour. The practical realization of this first installation opens vast military and civilian uses.

Since the tanks are completely submerged, the new storage system is radiation proof and also safe from atmospheric fall-out hazards. The tanks are virtually blast proof. Only a direct hit will shatter the newly designed rubberized fabric coating that is said to be stronger than steel.

Economy of operation as well as safety was also stressed. It is estimated that storage of many commodities in underwater tanks would cost approximately half the amount of conventional above-ground storage facilities.

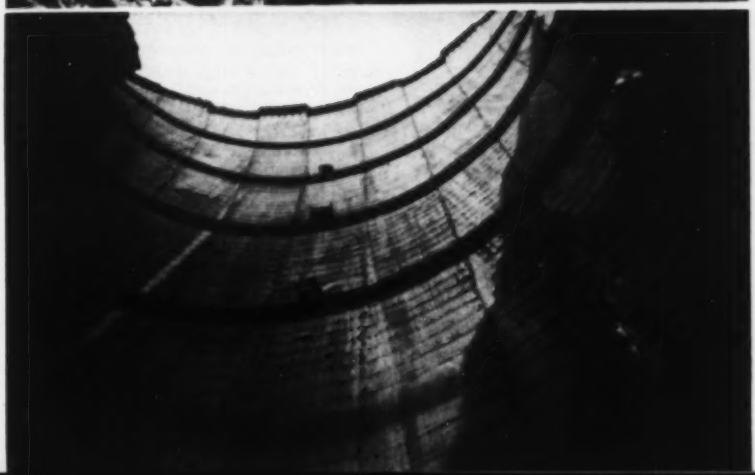
Fully loaded tanks can be easily towed by sea-going tugs from foreign or domestic ports and then lowered below the surface of the water to their cradles. Also, the fully loaded tanks can be moved from one resting place to another, by submarine or jet-turbine-powered helicopters.

The unique project was pioneered by the Jet Fuel & Storage Co., Washington, D. C.; the Firestone Tire & Rubber Co., Akron, Ohio; and the Global Marine Engineering Co., Los Angeles, Calif.

West Virginia Registration Board Adds Classification

The State Registration Board for Professional Engineers of West Virginia currently gives examinations for the registration of professional engineers in the branches of aeronautical, agricultural, ceramic, chemical, civil, electrical, highway, mechanical, metallurgical, mining, oil and gas, sanitary, structural and industrial engineering. At its last meeting held on July 8, three new classifications were added, with the result that examinations hereafter will be given in nuclear engineering, photogrammetric engineering, and community planning if requested by applicants for registration.

The practice of professional engineering in the State of West Virginia within the meaning and intent of the law includes any professional service, such as consultation, investigation, evaluation, planning, design, in connection with any public or private utilities, structures, buildings, machines, equipment, processes, work or projects, in which the public welfare is concerned, when such professional service requires the application of engineering principles and data.

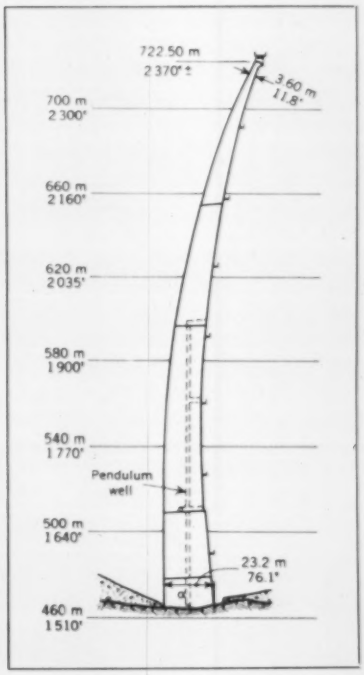


VAIONT DAM

CONCRETING WAS COMPLETED in August on Vaiont Dam, said to be the world's highest arch dam. More precisely, the Vaiont Dam is a "dome" structure with a perimetral joint along the abutment. It is located on the Vaiont, a tributary of the Piave River, near Belluno, in northeastern Italy.

Total height of the dam is 261 m (858 ft). It has a crest arch radius of 106 m (348 ft), reducing to 25 m (82 ft) near the base. The top thickness is 3.60 m (11.8 ft), and the base thickness 23.20 m (76.1 ft). The concrete volume is 352,000 m^3 (460,000 cu yd). Stone aggregate was produced some 1,400 m (4,600 ft) from the dam site and transported by an aerial tramway with a 330-m (1,080-ft) rise to a concrete plant at the top of the dam. Tilting mixers delivered concrete to a hopper truck for haul to a cableway with 436-m (1,432-ft) span, which placed the concrete.

The dam was designed by Carlo Semenza, F. ASCE, director, Societa Adriatica di Elettricita of Venice, and built for that organization.



U.S. Coast Survey Reorganizes For Improved Research

Secretary of Commerce Frederick H. Mueller has announced a reorganization of the U. S Coast and Geodetic Survey which provides for major shifts in program direction and emphasis in the areas of scientific research and oceanography. "These changes streamline and strengthen the organizational structure of the Survey, the oldest scientific bureau in government," Secretary Mueller said.

The changes are centered in two newly created offices: the Office of Research and Development, and the Office of Oceanography.

The Office of Research and Development will conduct basic research in the earth science fields of the Survey's work, and coordinate and assist in applied research and development conducted by the technical divisions. Working closely with the Survey's technical staff, scientists in related fields in other parts of the government, in universities and research institutions, and in private industry, the Office of Research and Development is expected to become the focal point for gathering and disseminating up-to-the-minute information on scientific research activities in the fields of oceanography, geodesy, geophysics, photogrammetry, and cartography.

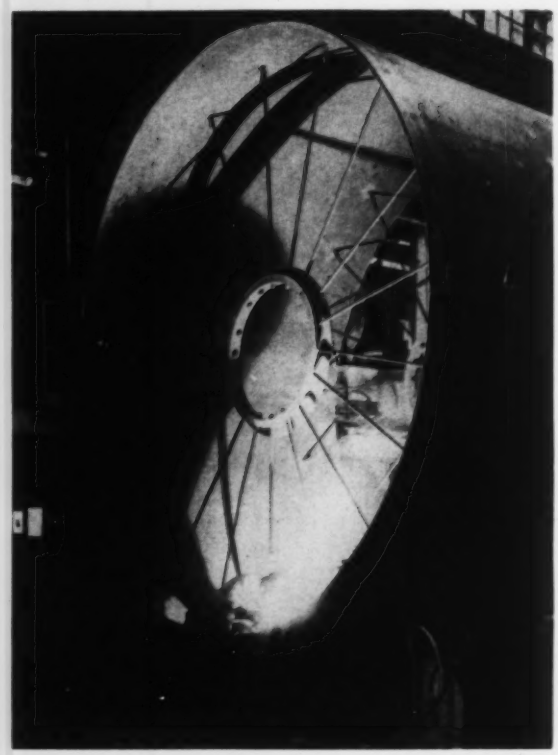
The Office of Oceanography will be responsible for a comprehensive program of oceanographic surveys, and a broad complex of programs related to the sea as one of man's major environmental elements. This Office, which will comprise all technical oceanographic activities and all supporting facilities for such activities, will be the framework for an expanded program in the field of oceanography which is planned for the next ten years.

Giant Cement Kiln Shipped to Argentina

The largest wet-process rotary cement kiln in the Western Hemisphere was recently shipped from Milwaukee to Loma Negra S.A. Compania Industrial in Argentina. Furnished by Allis-Chalmers International, as part of the company's $7.2 million expansion program, the equipment was shipped in 59 sections. Measuring 18 ft 6 in. by 17 ft by 18 ft 6 in. by 610 ft, the new kiln will increase yearly cement production by 730,000 tons at the South American plant. Its capacity will be 48,000 sacks (each 94 pounds) per day. Loma Negra is the largest cement-producing company in South America.

Port history is being made at the destination. To handle direct unloading of the 8,000,000-lb cargo, it was necessary to dredge a new slip and build a spur for the railroad siding. Design and manufacture of the equipment by Allis-Chalmers had to be made with an eye to the extremely difficult transportation problems involved. The St. Lawrence Seaway, with its 27-ft depth, made possible shipment from Great Lakes ports.

Financing of the cement mill was through a $5,900,000 credit extended by the United States Export-Import Bank. Allis-Chalmers extended an additional credit of $1,300,000. The $7,200,000 total includes transportation costs.



Welders are seen at work on an enormous wet - process rotary cement kiln. When the kiln was finished it was shipped in 59 sections from Allis-Chalmers headquarters in Milwaukee to Loma Negra S. A. Compania Industrial Argentina.

Forecasting Service For Cement Users

A unique monthly weather-forecasting service for users of cement has been initiated by the Alpha Portland Cement Co. It is the first specialized service of its type offered in the cement industry, and is available to all Alpha customers in the eastern half of the United States. The purpose of the service, which provides more detailed weather information than is available from the U. S. Weather Bureau, is to help contractors, ready-mix companies and concrete products producers plan their work for the coming month with better knowledge of what to expect from the weather.

The information contained in the monthly weather service is supplied to Alpha by Weather Trends, Inc., New York, a private firm of meteorologists specializing in long-range forecasting. Weather Trends studies in detail the weather problems in Alpha's entire trading area.

Each monthly forecast, printed in a four-page bulletin, predicts temperature and precipitation expected for one month in advance. Specific climatological data and forecasts are also included for key cities. Color-coded bar charts and weather maps tell at a glance what areas are expected to be colder or warmer and wetter or drier than usual. A detailed summary is included for each major region.

Bill Authorizes 120 Water Resources Works

The Army Corps of Engineers has been authorized to build 120 flood control, navigation, water conservation, and other water resources projects, located in 37 states and costing $1,385,694,300 under the new Rivers and Harbors Act signed by the President.

This is the first omnibus water resources development authorization bill since 1958. In addition to expanding the expenditure limitations on 11 river basin development programs, the new projects given the green light include 56 navigation improvements, costing $203,519,300; 44 flood control projects, costing $277,589,200; and 9 beach erosion control works, costing $22,345,800.

Among the new projects were authorizations for deepening 17 Great Lakes har-

bors to St. Lawrence Seaway channel standards at an estimated cost of $87,000,000, of which local interests would pay $12,000,000 and the Federal Government the remainder. The harbors slated for improvement extend from Duluth on Lake Superior to Rochester on Lake Ontario.

APWA Designates Public Works Week

A public education program to create greater awareness of the importance of public works to Americans, and particularly to those living in urban areas, has been launched by the American Public Works Association in cooperation with Kiwanis International. According to APWA President Jean L. Vincenz, F. ASCE, the program will be highlighted by the observance of National Public Works Week, October 2-8.

It is hoped that the program will help arouse an interest in young people in pursuing careers in public service. Another objective of the program is to keep the public informed of the important work being done by their public servants.

As part of the Public Works Week observance, the top ten "Public Works Men of the Year" will be selected by a special committee of the APWA.

New Port for Miami

Construction will start this fall on the new $20 million Port of Miami, a community planners' dream for 32 years. The objective of the project is Miami's development as the cruise center of the world. The new facilities also will attract freight shipping requiring ultramodern methods and speedy materials handling.

Combining functional beauty and easy accessibility with efficient operation, the port will include three major operating areas about a mile from Miami's downtown section. One will incorporate port service facilities and modern cargo handling; the second, five buildings of maritime office space; and the third, a passenger terminal with capacity to process three 500-passenger cruise ships through customs simultaneously. Another essential feature of the marine development will be a rail and vehicular causeway linking the port island with the mainland and Miami's in-process expressway system.

Construction is expected to start in October, with dredging and fill work set for completion in the first year. Site planning, bulkheading, and construction of the bridge to the mainland will be finished in the second year, with operation of a "usable port" anticipated by late 1962. The passenger terminal facilities will be erected during the third year, and transit shed and warehouse building will be completed by the end of the fifth year.

EXAM GEMS

by Reggie Strashu

R. ROBINSON ROWE, F. ASCE

EXAMGEM No. 14 was a simple exercise for young bridge engineers who had learned all about centers of floating caissons. The barge (Fig. 1) had the same centers—B, C, G and M.

G was the center of mass of the barge. Its location not being given, careful candidates pointed out the omission and stated their assumption, usually at centroid of barge. For stability moments, the weight of the barge can be concentrated at G, 2.5 ft below deck center at D.

B was the center of buoyancy, located at the centroid of the trapezoidal section of displacement. The resultant of all water pressure on the barge is the weight of the displaced water acting upward thru B.

C was the center of buoyancy for the barge when even on the keel, that is, on the axis at middraft. For a 50 x 20 barge displacing 105 tons in *fresh* water (another assumption to be stated), the draft was

$$d = \frac{(105)(2000)}{(50)(20)(62.4)} = 3.366 \text{ ft}$$

Hence the distance $CD = 5 - 1.683 = 3.317$ ft.

Most important is the metacenter M, defined as the intersection of a vertical thru B with the axis thru C, G and D. It moves very little as a vessel heels, the relation for a rectangular hull being

$$m = \frac{b^2 + 2f^2}{12d} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

in which m is the metacentric height CM, b is the beam, d is the draft, and f is the heel measured on the side of the barge.

In this problem f is also the freeboard and equal to $5\text{-}d = 1.634$ so with the given $b = 20$, Eq (1) computes CM = 10.035 ft. Subtracting CD will obtain MD = 6.718.

We are now ready to take stability moments about D. The arms for the forces at G and B are the horizontal projections of GD and MD, computed from the sine of the heel angle, $\tan^{-1} 2f/b$, hence

$$5x + (2)(\tfrac{1}{2}x) = (105)(1.084) + (98)(0.403)$$
$$6x = 153.27$$
$$x = 25.55 \text{ ft}$$

Frankly, few used the metacenter correctly. For example, one used the close approximation $m = b^2/12d = 9.9$ ft and then computed the righting moment from another approximation $M = 2fmW/b = 171$ ft-ton. Equating this to the boom moment $6x$, he found $x = 28.5$ ft, a 12 percent error. For a smaller heel, he would have been close by this method.

Most solutions attempted to coordinate the center of the trapezoid B relative to the moment center D; it was easy to slip or get lost in the series of little triangles. Those with more know-how divided the displacement by the dotted line, so as to have a rectangular area of $b(d\text{-}f)$ and a triangular area of bf, representing buoyancies of 54 and 51 tons, respectively. Centers of these simpler areas were easily found and projected on DL so that this moment equation could be solved:

$$6x = (51)(2.938) - (54)(0.667) + (98)(0.403) = 153.3$$

Some pity might be expressed for those who supposed the metacenter of a vessel was in the galley and the center of buoyancy in the wardroom mess. They tried to resolve the triangular pressures on each plane of the hull!

Gem quality is measured for this problem by the relative ease of the easiest way and the time penalty against other ways. Rationality of the two assumptions should also be rewarded.

EXAMGEM No. 15

Before leaving the subject of barges, here's a 17-year-old reminder that a barge is a structure.

Carrying two uniformly distributed deck loads (Fig. 2), a barge weighing 1,000 lb per ft draws 2 ft, both fore and aft. Considering the barge as a longitudinal beam, draw and dimension its shear and moment diagrams.

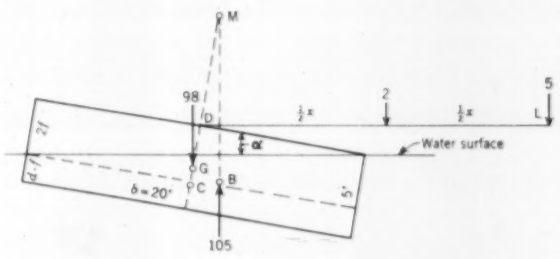


FIG. 1. Metacenter M serves to find maximum boom, x-DL, to lift 5-ton parcel from the dock.

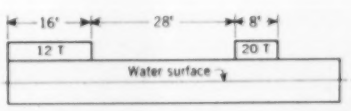


FIG. 2. This barge is also a beam supporting 12- and 20-ton distributed loads.

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All three jobs are parts of the Penn-Lincoln Parkway East in downtown Pittsburgh. A total of 4,250 tons of USS High-Strength Steel combined with 695 tons of A-7 steel, using both strength levels as good design dictated, were used to construct these modern over-passes and elevated structures. The designer and engineers were Richardson, Gordon & Associates, Pittsburgh, and the General Contractor, Fabricator and Erector was Fort Pitt Bridge Works, Pittsburgh, Pa. Concrete Contractor: John F. Casey Company, Pittsburgh, Pa.

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◀ **COST REDUCTION.** A typical 54-foot USS MAN-TEN Steel wide flange structural (33 inches deep) used as a stringer in this section costs $41.85 less than one made of A-7 steel (36 inches deep). With 28 spans and 140 such stringers between Stanwix and Grant Streets, in Pittsburgh's Penn-Lincoln Parkway, the total saving in favor of USS MAN-TEN High-Strength Steel is $5,859. Weight savings were 23⅛% in the stringers, and their depth was reduced three inches compared to the depth of the member that would have been required had A-7 steel been specified. Deflection requirements of the end cross girders in this, as well as other portions of this part of the Parkway, were such that A-7 steel was the more economical grade for these parts. Material costs (f.o.b. mill) and weight savings calculated by United States Steel.

29% WEIGHT SAVING. This curved ramp off Grant Street has 7 spans of 65 feet and 1 span of 77 feet using 850 tons of USS MAN-TEN High-Strength Steel and 100 tons of A-7 steel. Simple rolled beams of high-strength steel were possible instead of built-up plate girders of A-7 steel. This is responsible for a large reduction in weight and cost. Again, due to deflection requirements, cross members were A-7 steel.

GREATER STRENGTH—MORE CLEARANCE. Westbound Parkway ramp near 10th Street, crossing B&O freight yards. A good application where MAN-TEN High-Strength Steel reduced the depth of the girders, providing greater clearance. This section has 12 spans: 9 simple span plate girders 130' x 66" deep and 3 anchor plate girder spans with cantilever arms 180' to 199' end to end x 66" deep. 3,100 tons of MAN-TEN Steel were used in the girders and 560 tons of A-7 steel were used for expansion dams, diaphragms and shear locks. Weight savings estimated —about 26%.

New in education

Master plan for NCE .....

The New Jersey State Department of Education has given its approval to the basic suggestions contained in a master plan for an expanded *Newark College of Engineering* outlined recently by New York space utilization consultants, Taylor, Lieberfeld and Heldman, Inc. The plan calls for admission of 7,000 students by 1965 and for 12,000 by 1975, in addition to finding 178 additional qualified faculty members by the first target year and 275 more by the second. The first stage of the plan will be paid for by $7,000,000 allocated to NCE from the $66,800,000 public colleges bond issue approved by popular vote in last November's election.

Nuclear engineering curriculum .....

Beginning this fall the Graduate Division of the *New York University College of Engineering* will increase "the depth and scope" of its program in nuclear engineering. Under an expanded program, the college will offer the degree of Doctor of Engineering Science for students majoring in the field. One of the first institutions in the United States to offer such instruction—its program began in 1950—it has granted the degree of master of nuclear engineering since 1955. For further information write to Dr. James J. Barker, Associate Professor of Nuclear Engineering, College of Engineering, New York University, University Heights Center, New York 53, N. Y.

Engineering refresher series .....

The 1960-1961 Engineering Refresher Series designed to prepare prospective candidates for the professional engineering examinations and registration will be conducted for civil engineers from November 11 through January 28 by the *Engineering Institute of the University of Wisconsin* in the Engineers' Society of Milwaukee Building. The short courses will review engineering principles and theory as well as discussions and solutions of typical examination problems. Registration information may be obtained by contacting the Engineering Institute, 4020 Stadium Building, Madison, Wis.

Program in water resources .....

A new program to aid in the development of water resources will be launched by the *Case Institute of Technology*. The objective of the program will be to establish the means by which water policies for important watersheds can be developed and will concern both water allocation and control. An attempt will be made toward analytical description of the Great Lakes as a dynamic system which can be used to predict the influence of changes in water resources policies from various localities within the area. Initially, Case plans to focus its attention on the Lake Erie watershed.

Research in materials science .....

A $4.4 million research program in materials science has been announced by the *University of Pennsylvania*. The research program, to be conducted for the Advanced Research Projects Agency of the Department of Defense, will be concerned with experimental and theoretical solid state physics, structural chemistry, inorganic chemistry, ceramics and all phases of metallurgy, and will continue for at least ten years. The design of new materials for nuclear reactors, rocket engines, and other modern devices is based on this kind of research. Other ARPA contracts have been awarded to *Northwestern University* (first four years, $3.1 million) and *Cornell University* (first four years, $6.1 million).

Columbia receives Guggenheim grant ...

Columbia University's Institute of Flight Structures has been awarded a grant of $320,000 by the Daniel and Florence Guggenheim Foundation to support its program of research and education in flight structures for both air and space flight. A unit of the University's School of Engineering, the Institute was established in 1954 by a grant from the Guggenheim Foundation and is under the directorship of Hans H. Bleich, F. ASCE, professor of civil engineering. Students admitted to the program must have a Bachelor of Science degree in engineering, mathematics or physics.

Transportation planning for executives ..

A five-week course in transportation planning for executives begins October 16 at the *Transportation Center at Northwestern University*. The subjects will be presented by Northwestern faculty, Transportation Center staff, and guest lecturers from business. For further information write Eliezer Krumbein at the Transportation Center, 1818 Hinman Avenue, Evanston, Ill.

Ford Foundation grants for engineering

The Ford Foundation has awarded grants totaling $6.6 million for the advancement of engineering education. They go to *Stanford University*, *Princeton University*, and *Brooklyn Polytechnic Institute*. The Foundation has made grants totaling $26,150,000 since last fall when it began a program of strengthening engineering faculties, strengthening doctoral education in engineering, and supporting engineering curriculum development and experiment. The grants to Stanford University and Princeton University are designed primarily to help improve and expand programs at the doctoral level. The grant to Brooklyn Polytechnic Institute will permit it to establish an honors program designed to prepare outstanding students in their early undergraduate years for work toward the engineering doctoral degree. (See August 1960 issue, page 122.)

To help persons interested in a career in engineering teaching the *University of Michigan* has inaugurated a Fellowship Loan Program for Engineering Faculty Development. Holders of a master's degree in engineering, the related sciences, or mathematics can obtain up to $6,000 per year, plus tuition (three-year limit); a Fellowship of $2,000 per year; a $1,000-plus tuition Assistantship (Teaching Fellowship); or a "Forgivable Loan" up to $3,000 per year. The program is supported by the Ford Foundation. Requests for application forms should be addressed to J. C. Mouzon, Associate Dean, College of Engineering, University of Michigan, Ann Arbor, Mich.

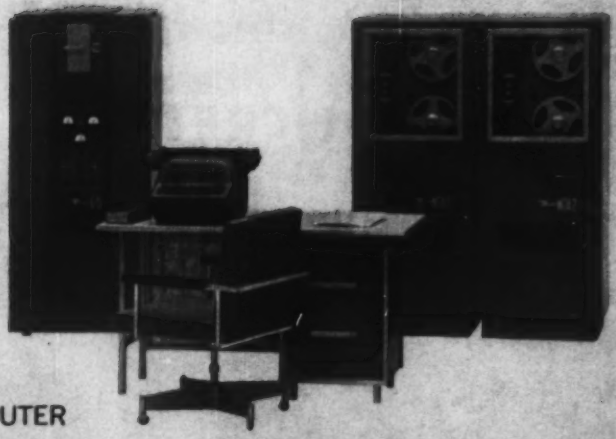
Aid to foreign highway engineers .....

The International Road Federation has announced that it will grant 53 fellowships for foreign highway engineers to study at American universities during the school year 1960-1961. These programs, which are part of an education project initiated by the Federation in 1948, include more than 250 graduate highway engineers from 68 countries throughout the world. All engineers will attend graduate engineering schools at Northwestern, Purdue, Yale, and Ohio State.

Increase in engineering graduates .....

Purdue University awarded more bachelor's degrees in engineering in 1958-1959 than any other U.S. university, according to a survey made by the Office of Education of the Department of Health, Education, and Welfare, and the American Society for Engineering Education.

The total number of degrees awarded in civil engineering at the *University of Illinois* during the academic year 1959-1960 reached a new high of 248. One-half of the degrees, or 124, were the Bachelor of Science degree and the other half were graduate degrees, which also reached an all-time high. While undergraduate enrollment for civil engineering at the University has been increasing slowly during the past several years, increases in the number of graduate students has nearly doubled since 1953. Forecasts are for additional increases in the fall of 1960.



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```
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R = 10 ⑤
F = 60 ⑤
L = ₀2 ⑤
FOR E = 100(50)300 BEGIN ⑤
FOR C = ₀00002(₀0000001)₀000021 BEGIN ⑤
I = E/SQRT(R ↑ 2 + (6₀2832 * F * L — (1/(6₀2832 * F * C))) ↑ 2) ⑤
PRINT (FL) = E ⑤
PRINT (FL) = C ⑤
PRINT (FL) = I ⑤
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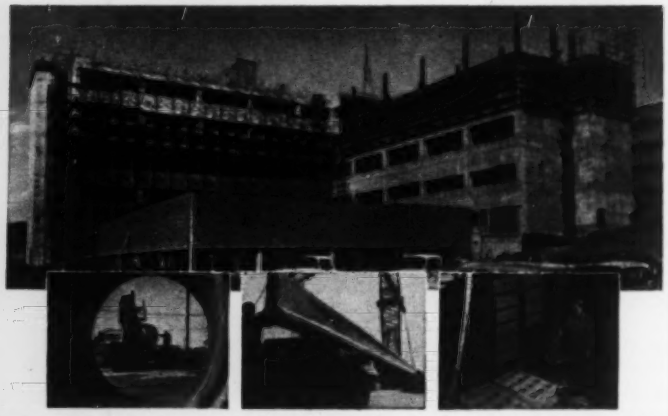

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DECEASED

William S. Baver (A.M. '16; M. '59), age 81, who at the time of his retirement last April 1 served as engineer-in-charge of the division of sewers in the Newark (N. J.) Public Works Department, died recently in that city. Mr. Baver began working for the Newark sewer division in 1931, having acquired experience as designer of the sewerage and drainage system at Penn State University; as design engineer for Montclair, N. J.; as the assistant engineer for Cincinnati, Ohio; and in a similar post in Johnstown, Pa.

B. W. Booker (M. '49; F. '59), age 68, retired California state highway engineer, who directed the planning and construction of the Bay Area freeway system, died in Oakland, Calif., on July 18. After 31 years of service with the California Highway Division, Mr. Booker became assistant highway engineer and head of the Bay Area nine-county operations in 1952. An advocate of a rapid transit system he was a consultant to the Alameda-Contra Costa Transit District and the Alameda County Highway Advisory Committee.

Reginald G. Clifford (A.M. '11; M. '59), age 78, a retired specialist in irrigation and drainage pumping works, died recently in Santa Barbara, Calif. For a number of years Mr. Clifford was a partner in the Youdall Construction Company. In 1939, he formed his own firm, the R. G. Clifford Construction Company, San Francisco, which he maintained until his retirement in 1951. His accomplishments included the design of Spaulding Dam for the Pacific Gas and Electric Company.

William Robert Frances Connell (M. '51; F. '59), age 64, for the past four years consulting engineer with Connell and Fletcher, Natal, Union of South Africa, died there recently. With time out for World War II, in which he served as major in charge of engineering units of the South African Engineering Corps, Mr. Connell was chief engineer and manager in the Capetown and Johannesburg offices of H. L. & H. Concrete Engineers from 1929 to 1950.

Brinton Brown DeWitt (A.M. '17; M. '59), age 74, died in Miami, Fla., recently. Mr. De Witt had been associated with the Porter-De Witt Construction Company, Poplar Bluff, Mo., for 22 years prior to his death. Earlier he was engaged in engineering and managerial capacities on sugar plantations in Puerto Rico and Cuba.

Guy M. Harbert (A.M. '17; M. '59), age 74, from 1936 until his retirement in 1956 assistant civil engineer with the U.S. Bureau of Public Roads, at Fredericksburg, Va., died recently in Galax, Va.

(Continued on page 104)

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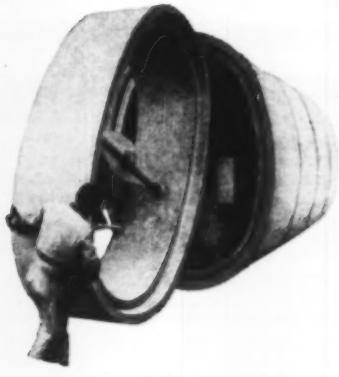

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Prior to 1936 Mr. Harbert was project engineer with the Virginia Highway Commission; county road engineer for Harrison County (W. Va.); and assistant engineer for the West Virginia Road Bureau at Morgantown.

John H. Harvell (A.M. '17; M. '59), age 72, for the past nine years secretary and treasurer of the Prince Land Company of Beckley, W. Va., died there recently. Mr. Harvell joined the company in 1951. Before that he had been a general contractor in the Beckley area; engineer of construction with the West Virginia State Road Commission; chief engineer of the Vaughan Construction Company; and resident engineer for the California Highway Commission in charge of construction of part of the highway system through Butte County.

Walter Harrison Lilly (A.M. '26; M. '59), age 71, first Federal housing director of San Antonio and first director of the San Antonio Planning Board which drew up the 1950 master plan for the city, died there recently. Predating the period of his public service, Mr. Lilly opened a general engineering office in San Antonio in 1926. Two years later he formed the partnership of Lilly and Drought, which was dissolved in 1936 when he became Federal housing director for San Antonio. From 1950 until his retirement in 1956 he maintained a consulting office in San Antonio. Mr. Lilly was a veteran of both World Wars.

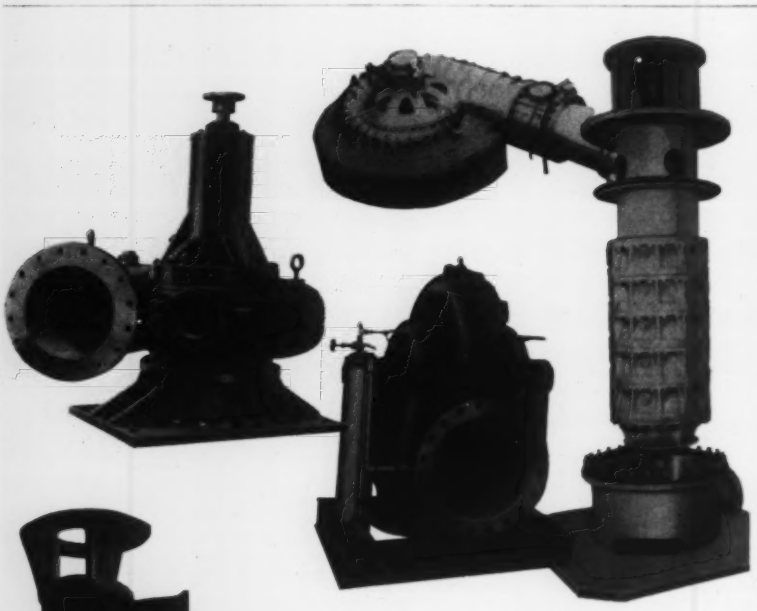
Thomas A. Lucy (M. '30; F. '59), age 74, designer and inventor of the Ingalls Truss, died recently in Baton Rouge, La. After early experience as chief engineer and superintendent of construction for various construction companies, Mr. Lucy joined the Ingalls Steel Products Company in Birmingham, Ala., as vice president and chief engineer, remaining there for several years. Later, he was consulting and design engineer on the construction of department stores, schools, office buildings, apartment houses, a hotel and a courthouse.

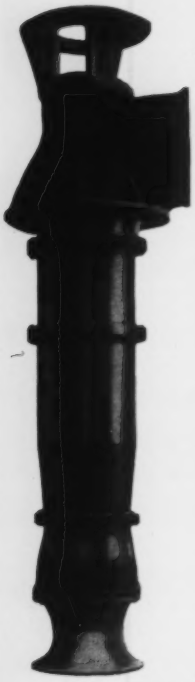
John H. McDonough (Aff. '23), age 72, a retired engineer of the Yonkers (N. Y.) Contracting Company, died in Albany, N.Y., recently. Mr. McDonough had over 45 years of experience on the construction of railroads, highways, and earth dams, which he gained as assistant engineer of highway construction at Santa Domingo, West Indies; as a partner in the contracting firm of McDonough & Moore, Brooklyn; as superintendent for the Sherman Power Company; and as a land surveyor, Brooklyn.

Isaac Oesterblom (M. '21; F. '59), age 82, builder of many outstanding structures in the United States, Latin America, and Asia, died recently in Hendersonville, N. C. Mr. Oesterblom's 50-year career included such projects as the Presidential Palace in Havana; Tsinghua College, Rockefeller Institute, Peking; the Hongkong and Shanghai Bank of Hangkow; Amoy Harbor; the Athletic Club in Detroit; and the American School at Darjeeling, India. He retired a few years ago.

Walter William Tuttle (M. '57; F. '59), age 67, of Pearl Harbor, Hawaii, died there on July 6. As director of the design division of the 14th Naval District's Public Works Office, Mr. Tuttle was responsible for the design and engineering of the whole Naval shore establishment. He had been in Federal service nearly 43 years—for 42 years in the Pearl Harbor area—and was to have retired on July 15.

Robert Graham Waitt (A.M. '47; M. '59), age 51, engineer at the Lockheed Aircraft Corporation plant near Marietta, Ga., died there on July 18. Upon graduation from the United States Military Academy in 1941, Mr. Waitt joined the Corps of Engineers. As chief in the Intelligence Division in the European Theatre during World War II, he had responsibility for mapping programs and activities in the area. He left the Corps in the early 1950's with the rank of Lieutenant Colonel to become assistant to the executive secretary in the Georgia Branch of the Associate General Contractors of America, Inc., at Atlanta.





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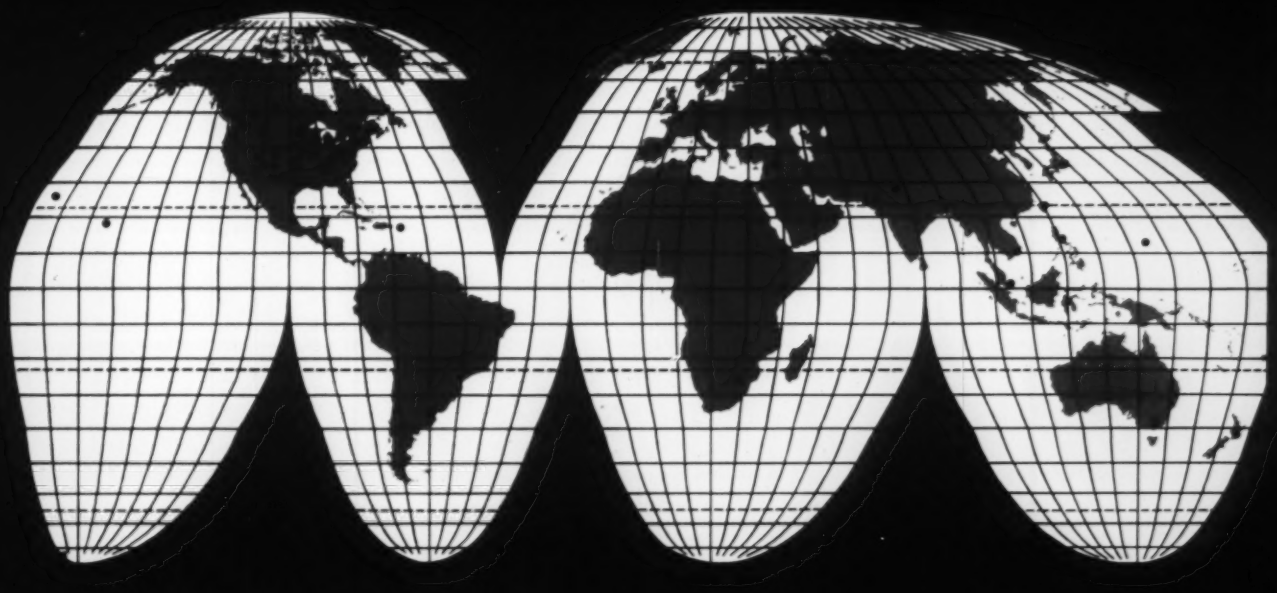

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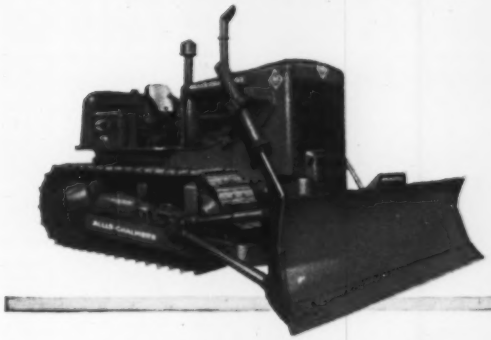

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News of Members

(Continued from page 28)

William E. Potter, Major General, U. S. Corps of Engineers, and governor of the Panama Canal Zone and president of the Panama Canal Company from 1956 until June of this year, is now executive vice president of the New York 1964-1965 World's Fair Corporation. In the past General Potter has supervised some of the Army's major engineering projects, including a $100 million Missouri River flood control project and a $60 million construction program in Alaska.

David C. Liu has been named an associate of Dames and Moore, Los Angeles consultants in applied earth sciences, and will have charge of the firm's recently established Honolulu office. Until recently Mr. Liu has been quality improvement engineer in the firm's Los Angeles office.

Lansing G. Simmons recently received the Colbert Medal of the Society of American Military Engineers for outstanding contributions to the advancement of military engineering through the development of basic techniques for geodetic and precision surveys required for national defense. As physical science administrator, Division of Geodesy, U. S. Coast & Geodetic Survey, he has devised basic techniques for positioning and orienting missiles, and guidance systems for missiles, at the Air Force Missile Test Center at Cape Canaveral, Fla. For several years Mr. Simmons was on the Executive Committee of the ASCE Surveying and Mapping Division.

William E. Peterson announces the opening of a consulting engineering office at 704 Arctic Building, Seattle 4, Wash. Mr. Peterson has specialized in concrete thin shells, prestressed concrete, and plastic steel. For the past two years he has been in charge of projects in Washington and Alaska for the Seattle consulting firm of Anderson-Bjornstad-Kane. He has also been with the Bechtel Corporation, of San Francisco, and Daniel, Mann, Johnson & Mendenhall, of Los Angeles.

Robert M. Brown, formerly chief of the Air Navigation Facilities Division in the New York office of the Federal Aviation Agency, has been named division chief of Region I, New York, by the FAA. For more than 20 years Mr. Brown has been an airways engineer, having served with the old Civil Aeronautics Administration. **Ronald W. Pulling,** who has been an airways engineer with FAA and its predecessor agencies since 1940, has been named manager of the Facilities and Materiel Depot at Oklahoma City.

Glenn Murphy has been named head of the newly formed Department of Nuclear Engineering at Iowa State University. The Nuclear Engineering program at Iowa State has been in operation for approximately 10 years under the direction of an administrative committee of which Dr. Murphy was chairman. Dr. Murphy is also head of the Department of Theoretical and Applied Mechanics at the university.

Stanton Walker and **Delmar L. Bloem,** director and associate director of engineering, respectively, of the National Sand and Gravel Association and the National Ready Mixed Concrete Association, received the Sanford E. Thompson Award of the American Society for Testing Materials at the recent ASTM annual meeting for their paper on "Variations in Portland Cement." Mr. Walker has been director of engineering of the National Sand and Gravel Association since 1926,

S. Walker

D. L. Bloem

R. E. Davis

and in addition director of engineering of the National Ready Mixed Concrete Association since 1930, while Mr. Bloem, who joined the National Sand and Gravel Association and the National Ready Mixed Concrete Association staff in 1945, has served since 1954 as associate director of engineering. Also honored at the meeting was **Raymond E. Davis,** professor emeritus of civil engineering at the University of California, who received the Frank E. Richart Award, which is presented about once in three years to a member of ASTM who has made notable contribution to the work of the Society in the field of concrete and concrete aggregates.

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HOT-HOUSE FRAMED BY COLD-BENT BEAMS—The largest and longest structural sections ever cold-bent from mill beams support the roof of the reconstructed Palm House of Chicago's Garfield Park Conservatory.

Johnston Iron Works, Chicago, used 21" WF 62 lb. beams cold-bent by COMMERCIAL to a radius of 50'. The contractor estimated that cold-bending of these 82' wide - 50' high arches saved 60% over conventional fabricating methods.

ARCHED CANOPIES FOR LOADING DOCKS—Central Division Headquarters, Northern Illinois Gas Company, Bellwood, Ill. Graham, Anderson, Probst & White, Architects and Engineers, specified 8" WF beams for roof-deck canopy support. Beams were cold-bent by COMMERCIAL and varied in weight from 24 to 40 plf. Accurate forming of beams by progressive bending to a 42' radius made the rise 1' 10" on a 24' span.

New Idea In Arched Roof Supports

ULTRAMODERN SCHOOL DESIGN—10" WF beams @ 31#/ft. and 29#/ft. were cold-bent by COMMERCIAL to varying radii 28 to 35'. These structurals are the load bearing members of the roof framing for the cafeteria and the diving pool of the new Lincoln Park High School, Lincoln Park, Michigan. To span varying widths up to 46' individual members were cold-bent to as many as 3 different radii. Eberle M. Smith Associates, Inc., Detroit, were the architects —Congress Steel Products, the structural contractor.

FOR THE FULL STORY detailing how large, wide-flange beams—progressively cold-bent by COMMERCIAL'S *patented process—saved construction time and money ...write to Commercial Shearing & Stamping Company, Dept. C-36, Youngstown 1, Ohio.*

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RECENT BOOKS

(added to the Engineering Societies Library)

Aero-Thermodynamics and Flow in Turbomachines

In Part 1 the fundamental relations for the analysis of arbitrary flows are derived from the general principles of fluid mechanics and thermodynamics applicable to the flow of any compressible media. This derivation employs vector and dyadic analysis, the elements of which are summarized in appendices A and B. Part 2 treats flows which are idealized either with respect to the properties of the fluids or the thermodynamics process they undergo. Part 3 discusses flows in turbomachines, wherein the concepts of Parts 1 and 2 are affected by the primary function of turbomachines, which is to change the energy level of fluids, and because the members guiding the flow in turbomachines are surfaces of revolution. (By M. H. Vavra. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1960. 609 pp., bound. $14.50.)

ASTM Standards in Building Codes; Supplement to 1958 Edition

Contains the new and revised standards and tentatives in the construction field since publication of the 1958 edition. Covers admixtures, mineral aggregates, asbestos-cement products, concrete, bituminous products, brick, clay and other non-metallic tile, gypsum, lime, mortar, building stone, plastics, refractories, wood, soils, and iron, lead, copper and steel and their alloys and variants. Fire and flash tests are also included. (Published by The American Society For Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1960. 253 pp., paper. $3.25.)

Calcul Rapide Des Poutres Continues Par La Methode de M. Caquot

"Caquot's method" for the rapid calculation of continuous prestressed-concrete beams has been adopted by the French government as a standard method, as being the best, simplest, and most rigorous among the many attempts at simplification of these complex calculations. In this book introductory pages explain the need for a method of rapid calculation and describe the Caquot method. In the following first and second major sections, the authors extend the method to apply for all systems and types of loads, first in theoretical and then in practical applications. Section three contains formulae for various load and beam systems. (By Marcel and André Reimbert. Editions Eyrolles, Paris, France, 1960. 260 pp., bound. NF. 35.45.)

Digital Computer Principles

An introduction for the interested layman, not requiring a background in electronics or mathematics. The emphasis throughout is on principles, illustrated with examples of circuits, devices and systems familiar to the author but not otherwise unique. The book moves from consideration of details, the basic elements and components, to general description and synthesis of total systems. Symbolic logic is given more emphasis than other subjects, due to the fundamental influence of logic in the behavior of the digital computer. (By Wayne C. Irwin. D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, N. J., 1960. 321 pp., bound. $8.00)

Effective Report Writing

Designed to serve as a text in communication courses or as a guide for professional personnel in business, government, and industry. For the inexperienced there are chapters on writing style, the organization and analysis of data using both primary and secondary sources, and the actual construction of the report. For advanced students there are descriptions and examples of reports in various specialized areas, such as accounting, engineering and government. Oral reports and letters of application also are described, and there is a detailed section on business letter writing. (By Norman B. Sigband. Harper & Brothers, 49 East 33rd Street, New York 16, N. Y., 1960. 688 pp., bound. $6.75.)

Fundamentals of Engineering Drawing

A shortened, combined version of two long-standing "classics" by the same authors, this text contains the elements of graphics necessary in engineering. It covers shape description, including instruments and their use, applied geometry, lettering, orthographic and pictorial drawing and sketching, sections, views, and conventions; size description; and the elements and techniques of working drawings. In addition to the usual illustrations and problems a considerable amount of reference material is provided. (By Thomas E. French and Charles J. Vierck. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1960. 115 pp., bound. $7.50.)

International Symposium on Stress Wave Propagation in Materials

In this volume are papers on current worldwide progress in the various areas of earth-layer propagation, viscoelastic materials, metallurgical effects, scabbing, rock breakage, and armor penetration. Research and analysis on various aspects of stress waves, inelastic materials, surface waves, seismic pulses, and photoelasticity are also presented. (Edited by Norman Davids. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y., 1960. 337 pp., bound. $10.00.)

Manuel de Pose des Pipe-Lines

A guide for engineers and technicians, this book also demonstrates one aspect of modern developments in construction processes and illustrates the application of assembly-line techniques to this field. An introductory chapter assesses the importance of pipe lines in the petroleum industry, describes the features of pipe-line projects unique among hydraulic projects, and gives a general survey of the elements of pipe-line construction. Succeeding chapters treat in turn each step in construction, such as location, survey, excavation, and final covering of the trench; transport, laying, bending and joining of the pipe; and miscellaneous topics such as special features of the construction camp, cathodic protection, intersection of pipe lines, and the crossing of existing lines and of bodies of water. (By Louis Lévêque. Editions Eyrolles, Paris, France, 1960. 181 pp., paper. NF. 24.35.)

Organizing the Technical Conference

A guide for those wishing to plan or participate in a technical conference, the discussion focussing on the organization of smaller gatherings. All conference techniques described have been successfully tried, though some are more experimental than others. Attention is given to the purpose and types of conferences, initial planning, program development, auxiliary, supporting and servicing activities, promotion and public relations, documentation, and evaluation and follow-up activities. (By Herbert S. Kindler. Reinhold Publishing Corp., 430 Park Avenue, New York 22, N. Y., 1960. 139 pp., bound. $6.00)

Photogrammetry and Photo-Interpretation, Second Edition

This is the second edition of "Aerial Photographs in Forestry," the title change indicating broadening of the scope to serve all who can use aerial photographs as a professional tool—geologists, soil scientists, botanists, geographers and engineers, as well as foresters. The five parts of the book discuss in detail aerial photographs, photogrammetry, mapping, photo-interpretation, and finally the special applications in forestry. (By Stephen H. Spurr. The Ronald Press Company, 15 East 26th Street, New York 10, N. Y., 1960. 472 pp., bound. $12.00.)

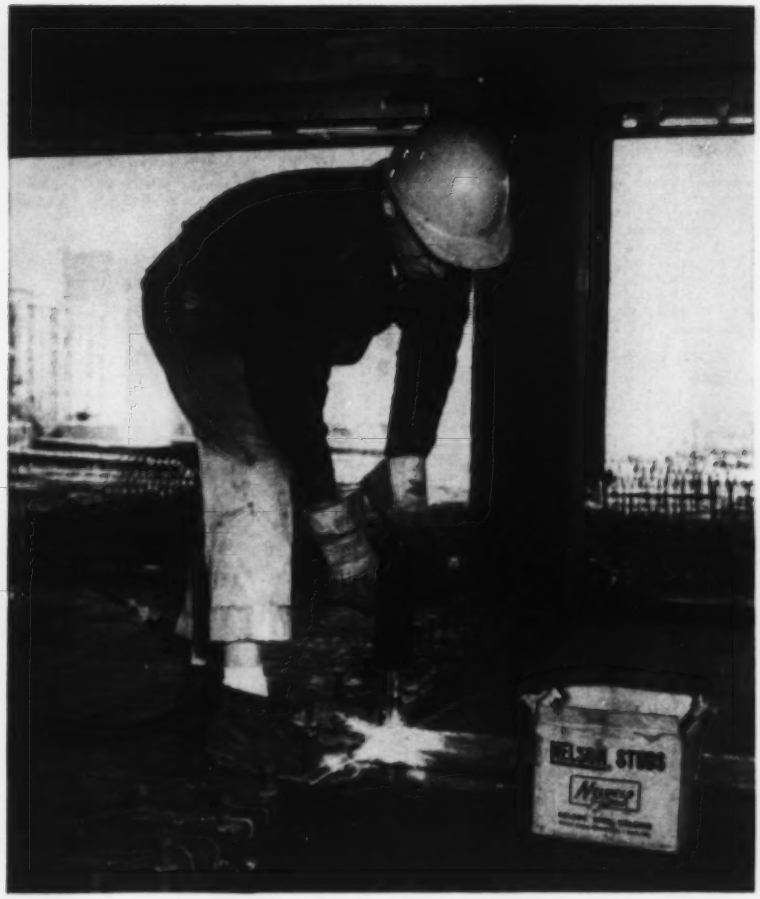
Professional Engineer's Examination Questions and Answers

This is the second edition of a useful book which reviews engineering fundamentals in preparation for professional examinations, using mainly past examinations given by various State Boards of Examiners as sources for problems. (By William S. La Londe, Jr. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, 36, N. Y., 1960. 589 pp., bound. $7.50.)

(Continued on page 112)

DOUBLED LOAD CAPACITY

...*after* steel framework is completed



Two rows of 2"-high Nelson Studs *were installed on varying centers to achieve composite action while providing greater flexibility of design, better concrete compaction and lower over-all cost. Nuts were run down on the threaded studs to provide optimum hold-down.*

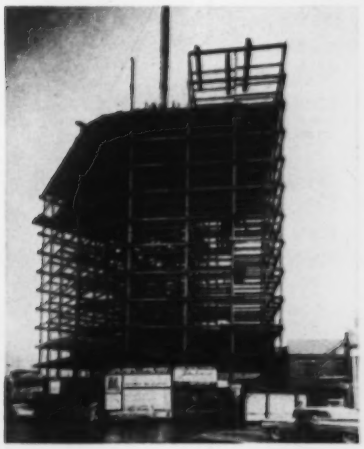
Composite Steel-Concrete Construction* Boosts Live Load Capacity from 50 to 100 lbs. psf

Composite construction was employed to double the loading capacity of the second and third floors of the new 13-story Mid-City Center... *after the structural steel framework for the first nine stories had been completed.*

This Forest Hills, N.Y. office building is, perhaps, the first to use composite design to increase the capacity of existing building construction. The leasing of five floors, or 40% of all the buildings office space, hinged on the owners' ability to meet the prospective tenants' requirement for doubled live load capacity to accommodate large electronic and other automated office equipment.

The approach of adding top and bottom cover plates to the standard short span construction was not feasible since the formwork had already been placed. Structural engineers, Abrahams, Hertzberg and Cantor, turned to economical composite construction, using stud shear connectors.

Other advantages and economies can be gained through composite design. For full information, call in your local Nelson Man, or write for "The Case For Composite Construction", Nelson Stud Welding, Division of GREGORY INDUSTRIES, INC., Dept. 10, Lorain, Ohio.



Mid-City Center office building, Forest Hills, N.Y. Architect: Jack Brown • **Structural Engineers:** Abrahams, Hertzberg and Cantor • **Chief Construction Engineer:** Murray Puchall of the Lefrak Organization (owners) • **Structural Steel Fabricators:** Holland Steel Co. • **Steel Erectors:** Atlas Erectors.

***A steel and concrete composite beam is made up of three essential elements: A steel beam, a reinforced concrete slab and shear connectors. Horizontal shear is transferred to the beam through the shear devices which join the slab to the beam in such a way as to cause the concrete and steel elements to act as a unit.**

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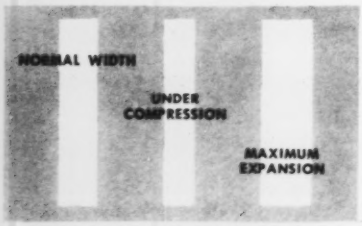

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Second Protective Construction Symposium, Proceedings: Deep Underground Construction

This large, two-volume loose-leaf collection of papers stresses primarily the design and construction of deep underground industrial facilities to resist the effects of nuclear weapons. Topics discussed include the need for shelters, weapons effects to be provided against, the interaction of utilities and structural solutions, tunnel design and failure mechanism, and experience from such fields as submarine design, oil-well drilling, and underground powerhouse design. (Compiled by J. J. O'Sullivan. The Rand Corporation. To be reprinted by the Macmillan Company, 60 Fifth Avenue, New York 14, N. Y., at $25 for the two-volume set.

Structural Mechanics

This book presents fundamental principles, emphasizing the mathematical treatment of structural theory bearing on indeterminate structures. It introduces advanced strength of materials topics such as finite difference approximations, Fourier series, and structural dynamics and stability, and includes consideration of beam columns, moment distribution for axially loaded members, and numerical method for deflections and buckling. Intended primarily as an undergraduate text, but designed also to be of use for more advanced study. (By Samuel T. Carpenter. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1960. 538 pp., bound. $9.50)

Water and Agriculture

The sixteen papers in this symposium on the agricultural use of water were prepared by experts in the respective fields, and were presented at a 1958 meeting of the AAAS. The papers are arranged in four major groups: water for the future; water sources; water planning and use; and water control. They touch on power, industrial, recreational, and other uses of water only where these impinge on agricultural uses. (Edited by Roy D. Hockensmith. American Association for the Advancement of Science, 1515 Massachusetts Avenue N.W., Washington 5, D.C., 1960. 198 pp., bound. $5.00.)

Water Supply and Sewerage
Fourth Edition

Presupposing a knowledge of hydraulics, this revised edition presents principles and present-day practices, introducing the subject with a discussion of sanitary engineering in modern life—the role of the sanitary engineer, the relation of population to consumption and disposal, and other problems. The supply of water is discussed in detail, including sources, collection and distribution, quality, clarification and filtration, and pumping stations. Sewerage is fully treated from the standpoint of sewer design, construction, maintenance, characteristics and flow; sewage disposal, sedimentation and filtration; sludge treatment and disposal; and miscellaneous problems. The final chapter discusses financing and management of the relevant plants and systems. (By Ernest W. Steel. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1960. 655 pp., bound. $11.00.)

Windscale

Intended mainly for civil engineers, this book provides a background for all who are interested in nuclear power station engineering and construction by describing the building of the Windscale Works in England. The choice and preparation of a site, and the construction of the pile chimneys and of the effluent pipelines is related. The author then describes the remedial operation for the biological shields of the piles, and the problem of supplying supplementary cooling air to the piles, and finally recounts some of the day-to-day maintenance problems of the reactors. (By Stuart Sinclair. George Newnes, Ltd., London, England, 1960. 136 pp., bound. 25s.)

Non-ASCE Meetings

American Institute of Electrical Engineers. Fall general meeting in Chicago, Ill., October 10-14.

American Institute of Mining, Metallurgical and Petroleum Engineers. Fall meeting in Denver, Colo., October 2-5.

American Institute of Steel Construction. Thirty-eighth annual convention at the Hotel Greenbrier, White Sulphur Springs, W. Va., October 30-November 3.

American Public Health Association. Eighty-eighth annual meeting at the Civic Auditorium, the Sheraton-Palace Hotel, the Whitcomb Hotel, and the Jack Tar Hotel, San Francisco, Calif., October 31-November 4.

American Society of Mechanical Engineers. Twenty-fourth National Exposition of Power and Mechanical Engineering at the New York Coliseum, New York, N.Y., November 28-December 2.

Engineers' Council for Professional Development. Twenty-Eighth annual meeting at the Queen Elizabeth Hotel, Montreal, October 3 and 4.

National Academy of Sciences-National Research Council. Ninth National Clay Conference under the auspices of the Council's Clay Minerals Committee at Purdue University, Lafayette, Ind., October 6-8.

National Association of Corrosion Engineers. An Oil and Gas Pipe Line Symposium will be held during the South Central Region Conference at the Mayo Hotel, Tulsa, Okla., October 25-27.

Water Pollution Control Federation (formerly the Federation of Sewage and Industrial Wastes Associations). Annual meeting at the Trade and Convention Center, Philadelphia, Pa., October 2-6. Executive Secretary Ralph E. Fuhrman, 4435 Wisconsin Avenue, N.W., Wash. 16, D. C.

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New Publications

Research . . . . The most important developments in the research program of the National Bureau of Standards during 1959 are described in the Bureau's Miscellaneous Publication 229. The 169-page reference, entitled "Research Highlights of the National Bureau of Standards," covers a wide range of scientific studies, laboratory experiments, and instrumentation developments. The publication sells for 55 cents and may be obtained from the U. S. Government Printing Office, Washington 25, D. C.

Land reclamation . . . . An overall plan for the reclamation of the Hackensack (N. J.) salt meadows has been prepared by the Passaic Valley Citizens Planning Association for consideration by the Meadowlands Regional Planning Board. The report, the fourth in a Master Plan Series, features the financing feasibility of plans for developing the vital 7,000-acre area. It was prepared by Ralph M. Field, associate planner in charge of the Meadowlands Program. Inquiries about the report should be addressed to Ernest Erber, Executive Director, Passaic Valley Citizens Planning Association, 312 Clifton Avenue, Clifton, N. J.

Highway accident costs . . . . A graphic and startling little booklet, entitled "You and the Cost of Highway Accidents," states the facts about the cost of motor vehicle accidents involving registered Utah passenger vehicles. The study—the joint work of the Utah State Roads Commission and the U. S. Bureau of Public Roads—will be useful in safety education programs and in determining the economic justification for highway improvements. Copies may be obtained from the Utah State Department of Highways, Salt Lake City 14, Utah.

Highway construction . . . . On-the-job innovations developed for the economical and efficient placement of welded wire fabric in single-lift concrete pavement are discussed in Technical Bulletin No. 246 of the American Road Builders' Association. Glenn S. Paxson, of the Oregon State Highway Department, is the author. Copies, at 50 cents each, may be ordered from the ARBA, World Center Building, Washington 6, D. C.

National Science Foundation . . . . With the national attention continuing to focus on science and technology, the National Science Foundation's Ninth Annual Report will be of considerable interest. The 274-page publication includes a photographic sampling of foundation-supported activities. Copies are available from the U. S. Government Printing Office, Washington 25, D. C. They are $1.00 each.

Flood control . . . . The fourth report of the Ohio water resources inventory project has been published as Bulletin 32 by the State Division of Water. Entitled "Floods in Ohio—Magnitude and Frequency," the bulletin contains records of floods at more than 200 gaging stations, analyzed statistically to indicate frequency of occurrence. It is a revision and extension of Bulletin 7 on the same subject, published in 1946 and now out of print. The report is particularly timely, as it makes all previous flood records available for comparison with the 1959 floods. The authors are W. P. Cross and E. E. Webber, hydraulic engineers for the U. S. Geological Survey. Bulletin 32 sells for $5.00 and may be obtained from the Ohio Division of Water, 1562 West First Avenue, Columbus 12, Ohio.

Guide to the space age . . . . Intended for the general reader as well as the specialist and technician, "Guide to the Space Age," presents in clear and simple language the terminology of modern space technology and guided missilery. The authors, in an effort to bring order to this vital area, have included a unique system of cross reference to guide the reader to the exact nomenclature and position of standard scientific terms and, wherever possible, have illustrative drawings and diagrams to clarify descriptions or concepts. (By Carl and Hazel Besserer. Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y., 1959. 320 pp., bound. $7.95.)

ECONOMY IN ACTION:

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Bordeaux Storm Drainage Project, Fayetteville, North Carolina
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JUNIOR SANITARY ENGINEER, degree 1959, B.C.E. (Honor graduate), A.M. ASCE. Seven month's part-time experience with consulting firm while attending N.Y.U. in the evening. Salary, $5,720 a year. Location desired, New York City. C-583.

CIVIL ENGINEER, M. ASCE, B.C.E. and M.S.-C.E., registered P.E., 35. Eight years of experience in all phases of highways and bridges including planning, designing, supervision and inspection of construction with emphasis on structures. Can handle projects from preliminary design to completed construction. C-584.

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., M.I.T; P.E., 30. Tri-lingual U.S. citizen (French and Italian) with building design—construction experience in Europe and U.S.A. Anxious to get back to Europe. C-585.

CIVIL ENGINEER, A.M. ASCE, M.S.C.E., 32. Four years of diversified experience with general contractor, both engineering and supervision; and three years' planning, design, reports, estimates. Desires position with construction or industrial firm. C-586.

CONSTRUCTION ENGINEER, A.M. ASCE, B.C.E., E.I.T. New York State. Six years of experience in bridge and building construction; from planning and design stage in the office, through supervision of actual construction in the field. Location desired New England or upstate New York. C-587.

CHIEF ENGINEER OR CONSTRUCTION MANAGER, F. ASCE, B.S.C.E. Registered P.E., married. Eleven years of experience in general construction—last eight years in engineering management of general construction company primarily engaged in commercial, industrial and institutional buildings; and four years in varied projects such as bridge, sewer and other heavy construction. Desire permanent position with opportunity for growth. C-588.

SANITARY ENGINEER, A.M. ASCE, B.C.E. (Sanitary Option) Co-op Plan, 29. Two and a half years of varied experience with major oil company, 18 months' co-op with railroad. Desire opportunity to make career in sanitary engineering. Location desired, East. C-589.

CONSTRUCTION MANAGER, A.M. ASCE, B.S.C.E., Registered as P.E. and L.S. in Connecticut. Eleven years of progressive field and office experience as field engineer to general manager of construction firm. Salary, $10,000 a year. V-590.

STRUCTURAL DESIGNER, M. ASCE, B.S. in General Engineering, P.E. in Georgia, 36. Eight years of experience in structural and mechanical paper mill design; two years as construction engineer and chief draftsman for steel fabricator; and two years as shopfitter and hull draftsman in shipyard. Supervisory experience. C-591.

TRANSPORTATION MANAGER, F. ASCE, AREA, 48. Twenty-five years of experience in public service and industrial transportation, including foreign work. Broad experience in railroad and industrial management, including advanced executive training. Salary, $15,000 a year. Available January, 1961. C-592.

CONSTRUCTION ENGINEER, A.M., ASCE, B.C.E., Experience as construction inspector, public works—six months; surveying and monitoring of maintenance—six months; supervision of maintenance and construction—two years. Salary, $6,500 a year. Location desired, New York City. C-593.

CONSTRUCTION SUPERINTENDENT, M. ASCE, B.C.E. Supervised, scheduled, coordinated subcontractors and contractors; checked layouts, concrete work, steel erection, interior trades. Salary, $10,000 a year. Location, New York Metropolitan area. C-594.

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., M.S.C.E. E.I.T. certificate, N. J. Presently facilities engineer, coordination and liaison duties of planning, designing, scheduling and installation of facility needs for plant engineering and power departments. Also was assistant project engineer of large housing project and office and field engineer for construction companies. Desire construction engineer position either plant or site. Minimum salary, $7,000–$7,500 a year. Location desired, East or West Coast. C-595.

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., P.E. in Pennsylvania, 30. Five years in responsible supervisory engineering position on design and construction of highways, airfields, foundations, earth fills, subsurface exploration and testing, materials investigations. Worked with federal government on military and civil works projects in Pennsylvania, New Jersey and Delaware. Salary, $9,500 a year. Location desired, East. C-596.

CIVIL ENGINEER, A.M. ASCE, B.S., recent graduate, single. One year drafting for State Highway Department. One summer with consultant firm. Salary, $5,400 a year. C-597.

CONSTRUCTION SUPERINTENDENT, M. ASCE, CE, 59. Well qualified as superintendent, with experience in survey, layout, specifications, inspection, evaluation of prestressed or R/F concrete structures, streets, roads, water and sewer systems, airways facility and general construction. Salary, $7,200 a year. Location desired, West, California. Se-1506.

CITY ENGINEER, A.M. ASCE. Registered CE, 37. Basic construction experience includes six years' carpentry, two years' heavy construction with Corps of Engineers, three years' office engineering design and administration experience in drainage, bridges, highway and right of way, and one year as construction resident engineer. Salary, $10,200. Prefer California. Se-1244.

JUNIOR CIVIL ENGINEER, A.M. ASCE, CE, 22. Recent graduate with three months' experience—surveyor (instrument), computations and drafting of field work; grading sheets, maps, records of surveys for consultant. Desire position in structural construction or other civil engineering field. Salary, $5,400 a year. Location desired, San Francisco Bay Area. Se-981.

CONSTRUCTION ENGINEER, A.M. ASCE, CE, Geol, 35. Five years of general engineering and construction work including heavy grading, highway construction and tunnels; engineering cost, extensive survey and layout experience. Prefer position leading to supervisory capacity. Salary, $7,800 a year. Se-1048.

CONSTRUCTION SUPERINTENDENT, A.M. ASCE, CE, 32, CE Lic and L.S. Ten years of experience planning, scheduling, supervising construction, inspection, public relations, site investigations cost and material estimate, structural design, draft on general construction of commercial, institutional public buildings, commercial air navigation aids; for contractors, architects and government. Location desired, West, Foreign. Se-1365.

DESIGN AND CONSTRUCTION ENGINEER, M. ASCE, CE, 37, Lic CE California. Five years of experience designing, planning, supervising construction of new installations and plant sites for aircraft company; fourteen years of experience in charge of survey, engineering office, calculation of quantity, estimate, design of sewer plants, water treatment plants, subdivision, buildings, streets, highways for contractor, municipal engineers, government. Salary, $9,300 a year. Location desired, California. Se-350.

PLAN, DESIGN, CONSTRUCTION, CE, 55 Lic CE, F. ASCE. For 26 years engaged in the plan, design, construction, maintenance and operation of highways and bridges, foreign and domestic. For six years was consultant for university. Also spent two years developing housing program for government. Salary, $12,000 a year. Location desired, D. C., Los Angeles, Texas. Se-314.

DESIGN AND CONSTRUCTION ENGINEER, M. ASCE, CE, 38. Lic CE, Kansas. Twenty-three years experience in charge of design, construction, traffic studies, drainage studies of highways, bridges, sewer projects, water and sewage treatment plants, for consultants and government. Salary, $9,000 a year. Se-270.

CITY ENGINEER, A.M. ASCE, CE, EIT, Wash., 26. Two years of experience on site analysis, preliminary structure studies, design, cost, estimate, draft, specifications on bridges, structures, public works. Two years tests on asphalt, concrete, steel, soils and wood, inspect and design river dam project. Military completed. Salary, $7,200 a year. Location desired, San Francisco, West Coast. Se-875.

PROJECT ENGINEER, M. ASCE, CE and MS Hydr., Engr., 39. Fifteen years of broad civil and mechanical engineering experience. Three years in chemical process industries. Experienced in layout, design and supervision of drawings and specifications for industrial projects, including administration and construction responsibilities. Salary, $10,000 a year. Location desired, Gulf Coast, Southwest, West. Se-792.

ARCHITECTURAL AND STRUCTURAL DESIGN ENGINEER, M. ASCE, CE, 30. Eight years of experience on design, construction and contract administration including building, paving, irrigation facilities and underground tanks. Some waterfront experience. Salary, $8,100–$8,400 a year. Location desired, San Francisco Bay Area. Se-699.

CONSTRUCTION MANAGER, M. ASCE, CE, 48. Twelve years on reports and design; and fourteen years as construction office engineer to superintendent. Experience in coordinating construction, various types of contracts and subcontracts. Salary, $9,600 a year. Location desired, Southeastern or Central California. Se-1864.

ENGINEERS

Permanent openings for qualified men experienced in the design of BRIDGES —BUILDINGS —EXPRESSWAYS —SANITARY FACILITIES. Prefer graduate registered engineers who seek long range employment with opportunity for advancement, in a growing organization.

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Positions Available

PROJECT ENGINEER, civil graduate, with experience in charge of design of urban and rural highways, streets and other municipal projects for consulting engineering firm. Company will negotiate placement fee. Location, Southwest. W-9413.

DEVELOPMENT VICE PRESIDENT for consulting engineering firm. Must be qualified administrator, capable of assuming responsibility for developing new accounts. Must have proven technical background, including technical registration, ASCE activities, (preferably on national level), and leadership activities in civic affairs. Ability to negotiate contracts with Federal and municipal officials. Submit resume with detailed description of present and past ten years; responsibility with five employers on higher references. Salary, $12,000-$15,000 a year. Location, West. W-9408.

STRUCTURAL ENGINEER, graduate civil, experienced in beneficiation plant design, to design reinforced concrete foundations for large gyratory crushers, cone crushers, rod mills and ball mills, as well as ore storage bins, mine and mill buildings, conveyor supports and galleries. Duties will also include layout and design of mill and domestic water supplies and large tailings disposal systems. Salary, $10,000-$13,000 a year. Company pays placement fee. Location, New York City. W-401(*b*).

ASSISTANT TO PAPER MILL SUPERINTENDENT, graduate mechanical, civil, chemical, electrical or industrial. 25-30, with three to five years of extensive mill experience preferably in a heavy process industry such as paper. Will handle special projects in paper mill under direction; coordinate paper mill activities with those of other departments; study and improve methods within paper mill, etc. Salary, $6,700-$8,000 a year. Location, central New Jersey. W-9387(*b*).

DESIGN ENGINEER, graduate civil, with seven to ten years of experience in structural and general civil engineering design, preferably with some experience in process industry. Will work as staff design specialist with complete responsibility for structural and civil components of process plants including railroads, roads, storm sewers, sanitary sewers and buildings. Salary, $8,640-$11,520 a year. Location, western Pennsylvania. W-9366.

SANITARY ENGINEER, graduate civil, young, with two years of experience in the design of water treatment and sewerage disposal plants, plus one or two additional years of experience in general civil engineering. Salary open. Location, New York City. W-9359.

SANITARY ENGINEER, capable of responsible charge of water and sewerage projects, five years' minimum experience, including investigation, reports, design, layout and construction supervision. Location, upstate New York. W-9335.

ASSISTANT OR ASSOCIATE PROFESSOR of Sanitary Engineering. M.S. or Ph.D. desired, with experience in design of water and sewage treatment plants, water and sanitary sewer systems, pumping stations and industrial waste treatment. Salary open. Location, East. W-9319.

JUNIOR ENGINEER, graduate civil or mechanical for field engineering, layout, material take-off and inspection, for a chemical plants division. Salary, $6,000 a year. Location, Pennsylvania. W-9305.

PLANNING ENGINEER, graduate civil, with five years of responsible experience in diversified aspects of engineering, economic investigations and planning of industrial, commercial and residential developments, transportation and major civil works. Ability to express complex problems and solutions in concise written reports. Permanent staff position. Location, New York City. W-9293.

CONCRETE ENGINEER, with several years of experience in concrete and concreting materials, with some experience desirable in the precast concrete industry. Location, New Jersey. W-9232.

TEACHING AND RESEARCH PERSONNEL, for sanitary engineering, instructor to associate professor with commensurate salary dependent on education and experience. M.S. or Ph.D. preferred but will consider man with design or research experience. Location, Mississippi. C-8210-Chicago.

TEACHER, at least MS (PhD preferred) and five or more years' experience in civil engineering work. Teaching experience desirable. Fields of specialization: soil mechanics or materials, test preferred. To teach undergraduate courses in areas of soils, highways, materials test laboratories and lower division courses in engineering. Assist. Professor or higher. Salary, $6,516-$11,688 a year, depending on qualifications, plus opportunity for consulting. Location, Central California. SJ-5424.

ARCHITECTURAL DESIGNER, to design, engineer and estimate commercial and industrial buildings and facilities; to design manufactured products such as for stores, libraries, laboratories, restaurants and banks, and miscellaneous furniture, equipment and fixtures. Salary open, commensurate with ability, experience and productivity. Location Central California. SJ-5447-R.

(*a*) JUNIOR AND SENIOR DESIGN ENGINEERS, Min.E, CE, ME or MetE degree. Require background in industrial design and drafting with previous experience in mining, milling, smelting or refining plants and facilities desired. Applicants for positions at junior level especially desired, but some seniors also. Salary, $7,200-$10,200. (*b*) CONSTRUCTION ENGINEER, Grad CE or ME experienced in all phases of plant construction, preferably in mining or mineral industry. Salary, $7,200-$8,400 a year plus benefits. Headquarters, Utah. SJ-5443-R.

ESTIMATOR, age open, contractor background, well experienced in take-off, extensions, pricing and preparing estimates for contractor's bid purposes. Must be fast, accurate, keen and knowledgeable. For general building contractor on commercial, hospitals, schools and light industrial buildings. Salary, $7,200 up depending on experience. Location, San Francisco. SJ-5443.

PUBLIC WORKS DIRECTOR, Registered CE desired. Can substitute engineering degree with broad public works experience. Building experience helpful. Ability to adhere to standards while maintaining good public relations. Start at $7,200 and grow with newly incorporated, rapidly developing city of 17,600. Location, Northern California. SJ-5441.

JUNIOR CIVIL ENGINEER, CE or StructI.E., at least two years of office design experience required to prepare shop drawing. Later will be trained in timber design and cost estimate by fabricator of structural glued laminated timbers for engineered structures. Starting salary, $7,200. Location, Pacific Northwest. SJ-5439-R.

DESIGNER, CE, under 45. Prefer at least five years of experience working on railroad structures, bridges—principally bridge design, grade separation work, and other railroad structures. Must be interested in railroading, for permanent position. Starting salary, $7,500-$8,160, depending on experience. Location, San Francisco. SJ-5437.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

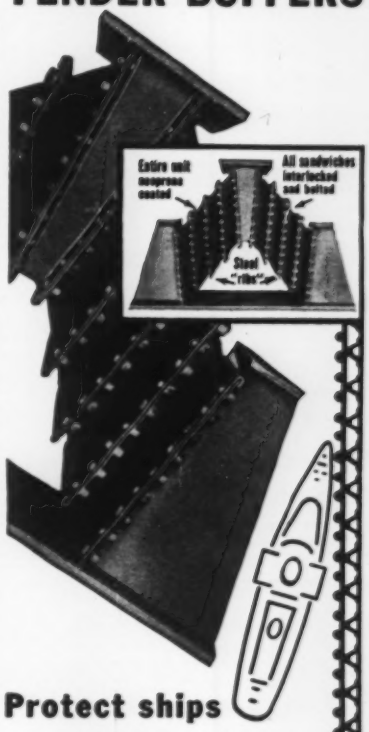
HYDRAULIC INVESTIGATOR, Grad, 50-60. Over twenty years of experience in field, office, negotiations, evaluation system reports of large area water resources, especially in relatively dry and primitive areas (probably largely wells). Should be qualified to establish and carry out preliminary study, establish and carry out field investigations for proof; consider and recommend initial pumping or procurement system and generally describe appropriate distribution system. Must be well qualified to operate at high level, tactful, diplomatic, able to secure exchange and resolve technical problems and carry out interchanges diplomatically for engineering building firm. Single status, 1 year. Apply by letter. Salary, $15,000-$18,000. Location, Middle East. SJ-5436.

DESIGN ENGINEER, CE, preferably California State Registration. Mature, about ten years of experience or more, with substantial background designing, laying out, drafting, preparing specifications in a consulting engineering office doing about $6 million of work per year. Excellent opportunity to participate. Salary, $9,000-$10,200. Location, Central California Coast. SJ-5433.

ENGINEERING CORRESPONDENT, CE, StructI. or Archt. graduate, under 35, good command of written English and able to understand and interpret technical information and make clear engineering calculation and sketches. Sound engineering background essential, preferably including design or other experience in light construction. In response to technical inquiries, advise and assist specifiers, builders and industrial users on matters pertaining to proper use of plywood. Assist architects and engineers in plywood structural design, prepare sample design, both for unusual and conventional uses. Some writing and editing of technical bulletins. Salary, $6,500-$8,500, depending on experience. Location, Pacific Northwest. SJ-5419.

FIRE PROTECTION ENGINEERS, engineering degree from accredited school, recent graduate to five years' experience, under 40. To train for and participate in surveys, evaluations and reports covering fire fighting facilities, structural conditions and conflagration hazards; work involves close contact and cooperation with municipal officials in western cities. Desire men with good appearance, ability to speak and get along well with persons in responsible positions for grading cities and towns of 25,000 and over. Will also include evaluation of reliability and adequacy of water supply, fire department, fire alarm system and other features. Cover eight western states. US citizens. Salary commensurate Headquarters, San Francisco. SJ-5422-R.

RUGGED RAYKIN FENDER BUFFERS



Protect ships and piers from docking damage

Here's a wonderfully-efficient dock fendering system, easy to install and inexpensive to maintain. Consisting of V-type arrangements of special rubber slabs bonded to tough steel plates, General's Raykin Buffers can be supplied, tailor-made, with deflection from 3" to 24" and energy absorption from 5,000 to 139,000 ft-lbs. Unaffected by corrosion, rotting, or aging, Raykin Buffers give positive, all-angle protection for harbor installations. Send the coupon for more information.

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Applications for Admission to ASCE, June 25-July 30, 1960

Applying For Member

SUKUMAR BANERJEE, London, England
RAYMOND WILLIAM BARSDALE, Sacramento, Calif.
HOWARD ALLEN BIGGS, Fort Wayne, Ind.
SISIR KUMAR BISWAS, Wad Medani, Sudan
PAUL BLAKE, Golden, Colo.
WILLIAM HOWARD BOUTWELL, Geneva, Switzerland
JOHN MANGULT BRIDGEFORD, Ventura, Calif.
ALBERT WILLIAM BRIDGEWATER, Montreal, Quebec, Canada
VINCENT PAUL CARLSON, Nashville, Tenn.
WAYNE ROGERN CARLSON, Kansas City, Mo.
GEORGE GWINUP CLARK, Tacoma, Wash.
PAUL EUGENE CLOUSE, Phoenix, Ariz.
JACK EDWIN CONNIFF, Mobile, Ala.
JOHN MOSHER DARLING, College Park, Md.
JOHN WORTH DAUGHERTY, Portland, Ore.
FRANK KENNETH DAWSON, Yuba City, Calif.
ELWOOD DEWITT DOBBS, Rochester, N. Y.
NAZIR AHMED DURRANI, Rawalpindi, West Pakistan
PAUL ADOLPH ELSNER, San Francisco, Calif.
RICHARD CHESNEY ELSTNER, Chicago, Ill.
IRA HENRY ERICKSON, Norfolk, Va.
CHARLES HARLAN FANKBONER, Bishop, Calif.
LEO FINZI, Milano, Italy
ROBERT FRANCIS GALLAGHER, Chicago, Ill.
JOHN WILLIAM GETTMAN, Denver, Colo.
WILLIAM IVAN GHARST, Fairborn, Ohio
KENNETH GREEN, Middleton, Wis.
EUGENE HOWARD GUNDERSON, Sacramento, Calif.
JOHN GERHRT GRONINGER, Denver, Colo.
WILLIAM ALVIS HALLMARK, Florence, Ala.
ALBERT HARUO HAMAMOTO, Honolulu, Hawaii
EZRA NACHMAN HENKIN, Kfar Vitkin, Israel
BOHDAN CHESTER HRYNIEWICZ, Cambridge, Mass.
JOSEPH ALVIN HUFFERD, Denver, Colo.
KAZIMIERZ JANKA, San Francisco, Calif.
KLAUS WERNER JOHN, Los Angeles, Calif.
ROBERT EUGENE KLEINGERGER, Elyria, Ohio
NORMAN MILLER LACK, Wilmington, Del.
JAMES BENJAMIN LAMPERT, San Francisco, Calif.
MORRIS JACK LIEBERGOTT, Philadelphia, Pa.
WUN-CHUNG LIU, Formosa, China
FRANK MADDOCK, Phoenix, Ariz.
JOSEPH DAVID MARKS, Omaha, Nebr.
STANLEY I. MAST, New York, N. Y.
ROBERT LEE MCCOY, Oklahoma City, Okla.
JAMES BEATTY MEANOR, JR., Washington, D. C.
FREDRICK JENNINGS MEIER, Stanton, Calif.
ARCHIBALD ABRAHAM MUCKENFUSS, Charleston, S. C.
JESSE EDWARD MUNDINE, Arvada, Colo.
JUSTICE ROBERT NEALE, New Orleans, La.
DINKER GORDHANBHAI PATEL, Tanganyika, British East Africa
EDWARD HARDY RICHARDSON, Newark, Del.
MICHAEL BELA RIGO, Caracas, Venezuela
ARJUN UTTAMCHAND RIJHSINGHANI, Chicago, Ill.
WILLIAM JOSEPH SCHNEIDER, Washington, D. C.
RICHARD WINTHROP ST. GERY, Washington, D. C.
FREDERICK STANLEY SHAW, Melbourne, Australia
GEORGE WILLIAM STANGEL, Augusta, Me.
GEORGE EDWARD STRUDGEON, Chicago, Ill.
STANLEY MONROE SMITH, Los Angeles, Calif.
WILLIAM JOHNSON TALBOTT, New York, N. Y.
FOH KWEI TSANG, Singapore
JOHN WILLIAM WEATHERS, Knoxville, Tenn.
JOHN JAMIESON WHITE, JR., Washington, D. C.
CHARLES EDWARD WILLIAMS, Houston, Tex.
DAVID ROBERT WITTES, Philadelphia, Pa.
HOWELL DEWITT WOOD, San Francisco, Calif.
WALTER LEWIS WOODWARD, Spokane, Wash.
JOHN BURHANS YERKES, Bryn Mawr, Pa.

Applying For Affiliate

WILLIAM EDWARD DIEHL, Bethlehem, Pa.
WILFRED GLOVER MCLENNAN, Chicago, Ill.
JAY M. WOLDENBERG, Chicago, Ill.

Applying For Associate Member

CHARLES LUCIEN ADAMS, Mobile, Ala.
QAZI ASHFAQ AHMAD, Madison, Wis.
SAMI AHMED, Minneapolis, Minn.
CHRIS ANGELIDIS, Gary, Ind.
KRISHNASWAMY ARUMUGAM, Berkeley, Calif.
ABDEL SHAKOUR OMER ATTIA, Washington, D. C.
PARTHASARATHY BANERJEE, Urbana, Ill.
MILO EUGENE BECK, Denver, Colo.
WILLIAM BJELKE, Lafayette, Ind.
JACK HADLEY BLACKMON, Angola, Ind.
MICHAEL RICHARD CABAK, San Francisco, Calif.
JAMES MCGRUDER CLARK, Mobile, Ala.
EUGENE DARRELL CALLAWAY, Richmond, Va.
TED ERNEST CONTRI, Reno, Nev.
SHUBHENDRA KUMAR DATTA, London, England
ANTHONY FRANCIS JOSEPH DIAS, Ontario, Canada
THOMAS VINCENT DOWD, Media, Pa.
HOWARD CARL DUTTI, Colorado Springs, Colo.
JOHN MICHAEL EDDISON, Teheran, Iran
LEWIS FLOYD FARGO, Levittown, N. J.
RIAZ FAROOQUI, London, England
RAFFAELE CLETO GRIPPO, Lawndale, Calif.
VIJAY NARHAR GUPCHUP, Cambridge, Mass.
WILLIAM EUGENE HEIRA, San Jose, Calif.
CHARLES D'ARCY DANIEL HOWARD, Edmonton, Alta., Canada
HAYATH MOHAMMAD ISMAIL, Madison, Wis.
HOVHANNES JEZMALIAN, Beirut, Lebanon
ENRIQUE KERFEL-KRIGER, Bogota, Colombia
KRISHAN KUMAR KAPUR, Chicago, Ill.
ERNEST GORDON KRUSE, Fort Collins, Colo.
DON MORTON LANDER, Garden Grove, Calif.
WESLEY LEON LAY, Bishop, Calif.
SAYED BEDAWI AHMED LAZ, Khartoum, Sudan
JOHN JOSEPH LENTZ, Baltimore, Md.
BERNARD LEUNG, London, England
VANCE CHRISTOPHER LISCHER, JR., Denver, Colo.
MAZHAR UL HAW SAEED AHMED MALIK, Seattle, Wash.
HIRANYA JIT MALLA, Kathmandu, Nepal
DONALD LESTER MATCHETT, Kansas City, Mo.
SYDNEY LEO MCGRATH, New York, N. Y.
WILLIAM PATRICK MCKEE, Los Angeles, Calif.
NORMAND LEONARD MOORE, Crossings, Calif.
DANIEL NADLER, Hartedale, N. Y.
AHMED KHAIRY NOOR, Champaign, Ill.
OCHIOGU ONYEKABA, Nigeria, West Africa
NAGINBHAI FAKIRBHAI PATEL, Uganda, British East Africa
RAMKRISHNA PUNJABHAI PATEL, New York, N. Y.
ROBERT CARLTON PEACE, Franklin Park, N. J.
RIMTAUTAS ANTANAS PETRAITIS, Los Angeles, Calif.
MARSHALL HENRY RAGAN, Nashville, Tenn.
VEERAL SABHARWAL, Kenya, British East Africa
MUKHTAR AHMED SHAIKH, Evanston, Ill.
ANDREW HAROLD STRING, Philadelphia, Pa.
KENNETH R. WARE, Mill Valley, Calif.

[Applications for the grade of Associate Membership from ASCE Student Chapter members are not listed. There were 900 of these applications in the June 25-July 30 period.]

the Old Shell Game

M & H does not believe that a business transaction should be a gamble, with either buyer or seller looking out for himself at his own risk. From the beginning of its career, the M & H Management has realized that a customer should become a friend. A customer should really be a silent partner—and not always silent, either, because his honest advice and opinion are extremely valuable.

So there has never been a place in the M & H organization for the old legal phrase of commerce i.e., "Caveat emptor" (Let the buyer beware). Instead, the confidence and trust of a customer always has been considered a Company asset of vital importance. A policy has been strictly followed to the effect that any transaction involving seller and buyer must satisfy both. Therefore, M & H Production Department always makes the best product it knows how—and the M & H Sales Department sees that a fair trade is made with the customer who buys it. The Company will certify its product is made in accordance with specifications, and will give the service for which it is designed.

In effect, M & H and a customer voluntarily become unofficial partners responsible for the service rendered by M & H products in use. It is a relationship of which the Company is very proud.

(No. 4 of a Series)

M&H VALVE
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FINAL REMINDER:

DON'T DELAY . . .

make your plans now to attend the ASCE ANNUAL CONVENTION and Civil Engineering Show

at Hotel Statler-Hilton, Boston, Mass.

October 10-14, 1960

- Technical and professional sessions and discussions
- Fourth ASCE-sponsored commercial civil engineering exhibit
- Demonstrations of equipment, materials, tools, methods
- Inspection trips to major engineering projects in the area
- Informal get-together—meet old friends, make new contacts

AMERICAN SOCIETY OF CIVIL ENGINEERS

1960 CIVIL ENGINEERING SHOW

LIST OF EXHIBITORS

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American Concrete Pipe Assn.
American Cyanamid Co.
Armco Drainage & Metal Products, Inc.
Chicago Pump Co.
Civil Engineering Magazine
Coakley & Booth, Inc.
Engineering News-Record
The Geodimeter Co.
Karol-Warner, Inc.
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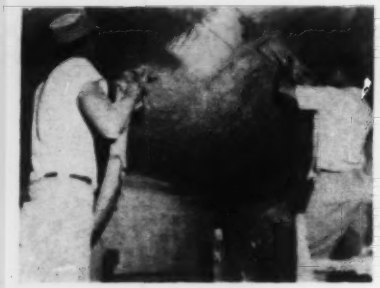
The Master Builders Co.
National Pool Equipment Co.
Nuclear-Chicago Corp.
Portland Cement Assn.
Raymond International Inc.
Sika Chemical Corp.
Soiltest, Inc.
Sonoco Products Company
Sprague & Henwood, Inc.
United States Steel Corp.
Wacker Corp.
Water Seals, Inc.

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Sprayed Limpet Asbestos



Applying Sprayed Limpet Asbestos

Finished Ceiling

RECENTLY THE CONTRACTORS for the new terminal building of the Midland Air Terminal, Midland, Texas, were faced with the problem of constructing a ceiling for an undulating, contoured roof. This is a costly and laborious process with conventional sheet or tile-type products since much cutting and fitting is required if any attempt is made to follow the roof contours and reproduce them on the ceiling.

But Sprayed Limpet asbestos proved to be an effective substitute. The 2-in. asbestos blanket followed the roof ripples faithfully, without filling in, and provided several additional benefits as well. The most important of these is acoustical insulation, a major consideration in an air terminal. Asbestos being, of course, fireproof itself, it contributes to the fireproofing of the entire building. It also provides some degree of insulation against the heat of Texas' summer weather, permitting the fullest utilization of the terminal's air conditioning. And, finally, the Sprayed Limpet economically provides a textured finish for the durable but unattractive concrete work.

Sprayed Limpet uses no flammable or toxic solvents; the asbestos leaves the hose nozzle as a stream of fiber mixed with a dry inorganic binder. It mixes in the air with clean water which is sprayed simultaneously from the nozzle. The resultant slurry is ready to "cling like a limpet" when it hits the surface to be covered. **Keasbey & Mattison Co., CE-9, Ambler, Pa.**

Instant Concrete Pipe

THIS COMPANY'S PORTABLE machinery casts on-the-job monolithic pipe in continuous-pour fed by ready-mix trucks, eliminating the necessity of manufacturing pipe in factories, freighting short sections of pipe to job sites and assembling by hand-sealing joints together.

Cost savings are realized with this "Inflataform" cast-in-place process because concrete and portable production equipment are taken directly to job sites. Pipe manufacturing and curing operations are handled in the pipe's permanent mold, a freshly cut ditch.

The new pipe-building equipment consists mainly of a slideable form that envelops and molds concrete around long, inflatable-deflatable rubber tubes at a rate of 8-12 fpm. Developed by the Goodyear Aircraft Corp., the hose-like inner forms create a smooth-bore as "slick" as the surface of the rubber covering on the forms.

Ditches are trenched to size and shape required for the outside configuration of the pipe and the slipforms follow the grade of the trenches. A troweling device on the pipelaying machine creates a "Roman arch" on top of the finished pipe which provides strength capabilities of more than 11,000 lb per linear foot. **Fullerform Continuous Pipe Corp., CE-9, Phoenix, Arizona.**

Pan Vibrator Attachments

THE USE OF A pan vibrator attached to the concrete paving spreader, rather than the more common vibrator drag tubes, increases concrete paving quality and production.

On one of its most recent projects—the placing of 217,000 sq yd of concrete over an 8-mi stretch of a 4-lane highway—Cameron, Joyce and Co. employed two pavers, two spreaders, a finisher and a combination finisher and float. The pan type vibrator was connected to the second spreader, set at a 24-ft width. The spreader's paddle-type mechanism distributed concrete evenly through a transverse sweeping motion, increasing paving production by eliminating the time normally consumed for spot dumping of concrete. This spreader requires no major maintenance other than that for normal chain wear.

Benefits of the pan vibrator attachment include: a better knit between reinforcing steel and concrete; a reduction in maintenance on vibrating equipment; and the sealing of air from top surface for better control of finishing operations. In addition, the pan vibrator attachment obtains power take-off from the spreader, reducing spreader operator responsibility for the operation of an additional engine for the tubes. **Blaw-Knox Co., Construction Equipment Division, CE-9, Mattoon, Illinois.**

Helicopter

A NEW 4-PLACE business and utility helicopter, sister ship of this company's 12 E widely used in construction, will go on the commercial market this fall. Designated the E 4, the 4-place copter is powered by a 320 hp Lycoming engine, a more powerful version of the 12 E engine. With more usable power than any other 4-place copter, the E 4 climbs vertically when fully loaded at 820 fpm. It can do the same heavy duty hauling and lifting as the 12 E, and the extra power is a big margin of safety for executive and other high priority passenger transport. **Commercial Division, Hiller Aircraft Corp., CE-9, Palo Alto, Calif.**

Bridge Surface Protection

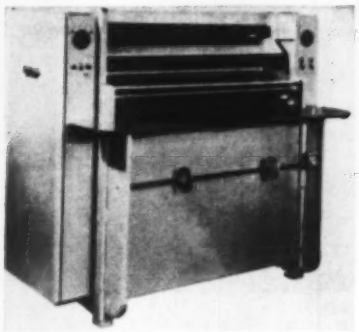
JENNITE J-16, A PROTECTIVE COATING for concrete surfaces, is now being extensively used on New York Thruway bridges. Jennite J-16, with special abrasive grit, is said to protect concrete bridge surfaces against water and salt penetration as well as freeze and thaw damage. The latter is particularly important because of the vast quantities of ice melting chemicals used to make bridges safe for motorists. Another characteristic is the result of absorption of added quantities of heat by Jennite J-16's black surface. This raises the pavement temperature under ice and snow and speeds thawing. **Maintenance, Inc., CE-9, Wooster, Ohio.**

EQUIPMENT MATERIALS and METHODS

(continued)

Reproduction Machines

THIS COMPANY OFFERS two compact diazotype reproduction machines that incorporate many features that have been successfully used in higher capacity whiteprinters. The Model 40 and the Model 60 in the Revolute Meteor line can be operated at speeds up to 35 fpm, and they have a printing width of 42 in. Model 40



Compact Diazo Machine

features a 2000 watt (40w/in.) lamp and Model 60 features a 3000 watt (60w/in.) lamp. A diaphragm pump provides ammonia in exactly the amount required to match machine speed. Rugged cast aluminum frames assure maximum rigidity, and jig-drilled holes provide accurate and permanent alignment of bearings and rollers. **Paragon-Revolute Division, Charles Bruning Co., Inc., CE-9, Mount Prospect, Illinois.**

Hard Rock Drills

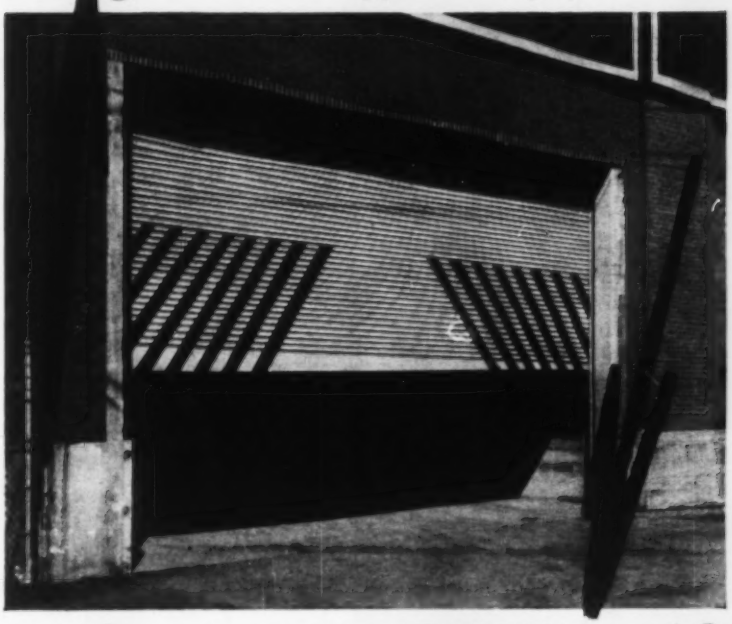
"MOLE-DRILS" NOW COME IN three sizes, ranging from 4 in. to 6 in., and are designed and engineered for hard rock drilling in construction, quarry and mining operations.

The percussion type "Mole-Dril" screws directly onto your drill pipe and works at the bottom of the hole directly on the rock face, with no power loss between the hammer and the bit, regardless of drilling depth. For cleaning cuttings from the hole there is high pressure air from holes in the bit, and exhaust air from the cylinder. With just three moving parts, valve, hammer and piston, there is easy disassembly and a minimum of maintenance.

Additional features include a backhead fitted with a positive action valve for drilling in wet formations; an auto-

(Continued on page 123)

UP goes door efficiency –



as door costs go DOWN, with

Kinnear Rolling Doors

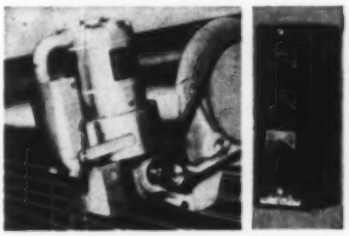
The *coiling upward action* of Kinnear Rolling Doors saves time, manpower, and money!

The curtain of interlocking steel slats, *originated* by Kinnear, provides *vertical* door action at its very best!

All floor and wall space is fully usable at all times.

Even ceiling areas remain completely clear; leaving maximum room for use of hoists, lift trucks, and similar equipment.

When closed, the doors form all-metal barriers against wind, weather, intruders, and vandals.



Kinnear Power Operators give time-saving, push-button control of Kinnear Rolling Doors — from a single point or any desired number of convenient locations.

Steel or Aluminum

Kinnear Rolling Doors are made of steel, aluminum, or other metals. Built to fit any opening in old or new buildings. Motor, manual, or mechanical control.

Steel Doors Heavily Galvanized

Heavy, hot-dip galvanizing gives Kinnear's steel doors lasting resistance to corrosion and the elements (1¼ oz. of pure zinc per sq. ft. of metal, ASTM standards). Kinnear Paint Bond makes them ready immediately for thorough coverage and adherence of paint.

Write for full details on Kinnear Rolling Doors.

The KINNEAR Mfg. Co.
FACTORIES:
1080-90 Fields Ave., Columbus 16, Ohio
1742 Yosemite Ave., San Francisco 24, Calif.
Offices and Agents in All Principal Cities

KINNEAR ROLLING DOORS
Saving Ways in Doorways

Note the clean, uncomplicated construction, the attractive architectural features, the enormous span.

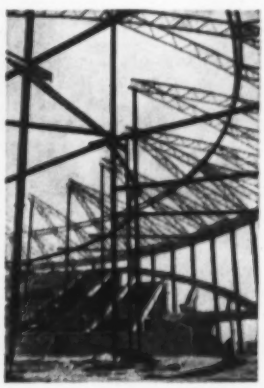
There's an Inland Structural Steel for every new construction idea

Domes

making full use of the versatility of structural steel, easily span tremendous unobstructed areas—meet every requirement for ease and speed of erection, light weight, beauty and economy.

Prefabricated structural steel members are delivered to the site ready for immediate use. Erection is speedy and uncomplicated, with little field fabrication required. Ribs can be small trusses, light weight I-Beams or similar structurals. The light weight, self-supporting nature of such domes eliminates the need for the dead weight of heavy wall construction. Temporary steel columns support the compression ring during erection—eliminate expensive falsework.

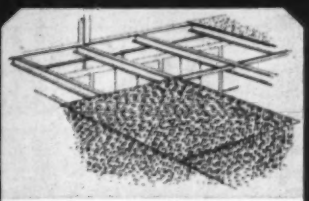
Temporary supports of steel, easily salvagable, are used to support the trussed ribs during construction.



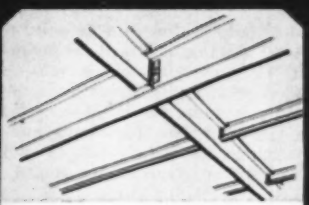
For complete information on the considerable savings achieved on many steel domes, see your local fabricator who now has structural steel available in all shapes and sizes—or call the American Institute of Steel Construction office in your area.

Use Steel *For Modern Construction*

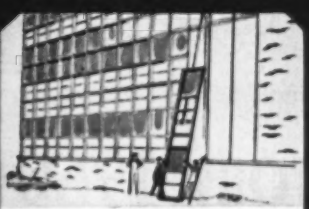
other inland construction products



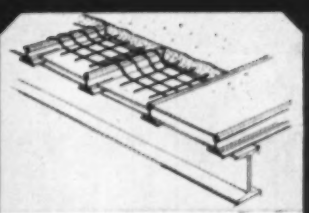
4-WAY SAFETY PLATE has come into general use as an integral, prefabricated part of the supporting structure, providing durable floors and added strength.



WIDE FLANGE BEAMS are the answer wherever more strength with less weight, longer spans with more open floor area, is the goal. Sizes from 8" to 24".



INLAND ENAMELING IRON is ideally suited to curtain-wall and enameled panel systems, providing strength, beauty and unlimited design possibilities.



INLAND SUB-PURLINS are especially designed to provide a lighter, more efficient member for shorter-span roofs. They come cut-to-length and mill painted.

INLAND

INLAND STEEL CO.

30 West Monroe Street
Chicago 3, Illinois

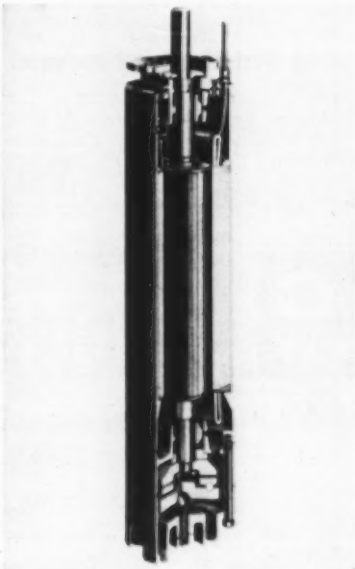
EQUIPMENT, MATERIALS and METHODS

(continued)

matic drifter type valve for short stroke fast action; a cylinder, carburized for maximum resistance to abrasion; and replaceable tappet bushing making straight hole drilling possible. "Molebits" are available in sizes ranging from 4¾ in. to 8 in. **Gardner-Denver Co., CE-9, Quincy, Illinois.**

Turbine Pump Motor

THESE NEW WATER-COOLED, water-lubricated motors, rated from 30 to 250 hp, 3 phase, 60 cycle, 1800 rpm, for 10 in. or larger well casings, are designed to be continuously submerged in water at a maximum temperature of 40°C for deep



Turbine Pump Motor

wells, booster or process application. The use of water as the cooling and lubricating agent eliminates bulky and hard-to-maintain pressure systems. No oil or other fluid is used which can contaminate well water. An extra large water filter keeps out foreign matter. The large surface area reduces danger of clogging with sand and silt. Shaft seals in the bracket force the water to travel along the shaft and through the filter. The motor frame is a heavy-walled, stainless steel tubing rugged enough to stand up to any abuse of impact during transportation or installation. Other features include: low friction losses, longer insulation life, special rotor and stator protection and self-aligning guide bearings. **Westinghouse Electric Corporation, CE-9, P.O. Box 2099, Pittsburgh 30, Pa.**

Roof Bolt Assembly

THIS NEW ROOF BOLT assembly features a locking keyhole plate, new bolt head design and a unique spring bail. A small hole in the bottom of the shell provides a snug hole which won't let the bolt wobble when the unit is inserted in place. Since the bolt and plug remain in perfect alignment, possible stripping of the threads is eliminated. The bail has enough tension to hold the entire assembly in place in the mine roof until the installer tightens the unit in solidly, eliminating the use of a palnut, and an enlarged neck under the bolt head locks the bolt in the center of the plate, eliminating plate walking.

Pre-assembly with the advantages of a small center hole are the features of the new locking keyhole plate. Bolt head pull-through is eliminated and friction reduced with a tapered bolt head and flat bearing surface on the plate. Less torque is necessary during installation. The uniform expansion of the four-fingered unit shell coupled with single unit construction, with the use of the spring bail, produces a solid gripping action in the mine roof. **"W"-HOLEGRIP, Connors Steel Division, H. K. Porter Co., Inc., CE-9, P.O. Box 118, Huntington, West Virginia.**

Electrical Conduit

A NEW LINE OF rigid Koroseal vinyl electrical conduit has been developed. It is recommended by the manufacturer for all types of electrical conduit systems and telephone circuits and is especially useful where unusual corrosive conditions exist. Due to its flexibility, Koroseal conduit fits the contours of installations and can be quickly snaked into place whether the runway routing is in earth, poured concrete or hollow walls. Koroseal conduit comes in 20-ft lengths, requiring fewer joints than the shorter lengths of conventional conduits, and it weighs ⅛ to ¼ as much as metal conduit. It is fire-resistant, self-extinguishing, non-magnetic and will not spark when struck. It can be cut with an ordinary hand saw, tubing cutter, hack saw or power saw; it can be bent easily after heating, can be threaded with the same tools used for metal conduit, and can be joined by solvent welding which provides a joint stronger than the conduit itself. **B. F. Goodrich, CE-9, Akron, Ohio.**

Low Cost Test Stand

NOW AVAILABLE at ⅓ cost of built-in-plant test stands, this Universal unit manufactured to ASME requirements

(Continued on page 124)

will test all valves including Globe, Gate, Plug Cocks, Safety and Relief plus other hydraulic-pneumatic equipment. The Farris Test Stand can be used to reset valves to use them in the widest possible variety of applications and pressure variations. The test stand's built-in compressor provides a useful source of compressed air for general plant service.

Easy to operate, the universal test stand requires no special skill or training. All controls are within reach on one panel with simple instructions printed on a metal plate. It is compact yet its wide range permits testing of pressure settings up to 2000 psi for air and 6000 psi for water. **Farris Engineering Corporation, CE-9, 709 Commercial Ave., Palisades Park, N. J.**

Corrugated Aluminum Culvert

A NEW PRODUCT for use by the culvert manufacturing industry is corrugated aluminum culvert sheet. Aluminum culvert has been tested in the basic soil types found throughout the United States with some 40 field sites constructed which also supply load data. These tests indicate the superiority of aluminum for applications in most soil types, and also show that corrugated aluminum culvert sheet satisfactorily withstands the loadings to which culverts are subjected.

The weight of aluminum culvert sheet is ⅓ the weight of its steel counterpart and 1/35 the weight of concrete. It has superior corrosion resistance and excellent general underground characteristics.

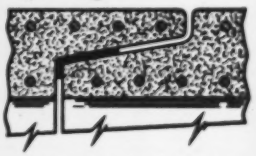
The sheet is corrugated at the manufacturer's rolling mills and delivered uncurved to the culvert manufacturers, who in turn curve the sheets on their present equipment and rivet the sections together. The aluminum culvert can be cut with conventional hand and power saws. **Kaiser Aluminum & Chemical Corporation, CE-9, Kaiser Center—300 Lakeside Drive, Oakland 12, Calif.**

Tunnel Wall Cleaning Attachment

THE ENGINEERING STAFF of the city of Wellington, New Zealand was faced with the problem of cleaning the walls of a 2045-ft long road tunnel. The work can only be done at night due to the press of vehicular traffic during the daytime hours. The engineers built a special mechanized attachment for one of this company's, Gradall machines. With the use of the special rotary brush attachment, a one-man crew was able to handle the cleaning job in the tunnel which is 29-ft wide and has walls 25-ft high. The result was greater efficiency and speed than had been attained by previous manpower methods. The attachment consists of a Briggs and Stratton 6 hp motor driving through a 6:1 reduction at 500 rpm, a fan and a group of three wire brushes, giving a total cleaning width of approximately 6-ft. The complete attachment is spring loaded on a base secured to the normal tool brackets on the end of the telescoping Gradall boom. The spring mounted attachment successfully adapts itself to all minor variations in the tunnel wall structure in relation to the Gradall boom. The operator is able to use a positive control and many movements of the Gradall boom to do the cleaning job as with a giant arm with full wrist motion. **The Warner & Swasey Co., CE-9, 5700 Carnegie Ave., Cleveland, Ohio.**

TYLOX "C"
Rubber PIPE GASKETS

. . . provide visual proof of correct pipe coupling



TYLOX "C" Gasket under full compression. Note the visual inspection feature.

Hamilton Kent Type "C" TYLOX Gaskets for concrete sewer pipe provide watertight joints at head pressures up to 50 feet. Gasket consists of base, multiple sealing fins and *inspection flange* which overhangs the edge of the pipe tongue, or alternately, the tongue offset, according to the type of pipe.

"C" Gaskets are of true compression type, made of either rubber or neoprene. They may be installed at the job site, or pre-assembled at the pipe manufacturer's plant. Compounded specially to resist sewerage and industrial waste acids, they never deteriorate. Under ground and under compression, TYLOX "C" Gaskets outlast the pipe itself. Write for brochure.

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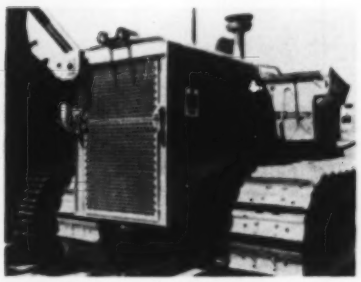
EQUIPMENT MATERIALS and METHODS

(continued)

Heavy-Duty Radiator Guards

A NEW, HEAVY-DUTY, one-piece, wrap-around radiator guard affording increased protection to the radiator core, front-mounted pumps and cable controls is now available for International TD-20 and TD-15 crawler tractors. The heavy-duty outside plate, formed from ⅝-in. steel plate, adds strength to the front of the tractor and conforms with the current styling trend of the International line. The swing-out, access door permits easy cleaning of the radiator core, and an improved dowelling arrangement makes for ease of assembly.



Wrap-Around Protection

On tractors equipped with hydraulic blades, the guards offer an improved hydraulic tank and pump-mounting arrangement. The lower hydraulic tank now has a 100 per cent full-flow filter at the base of the guard. **International Harvester Co., CE-9, 180 North Michigan Ave., Chicago 1, Illinois.**

Waterstop Splicer

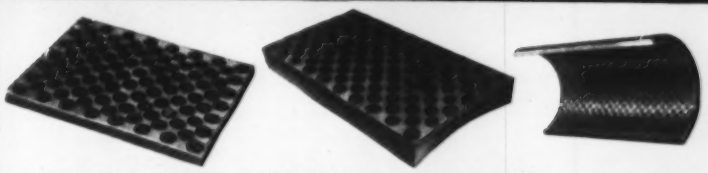
A NEW WATERSTOP SPLICER was developed for splicing all sizes of Nervastral Waterstops, the waterstops that are formulated from a compound based on polyvinyl chloride and other high polymer resins.

The manufacturers claim that Nervastral Weldbar (patent pending) is the most impervious, fool-proof and easy-to-apply waterstop splicer ever engineered for this purpose. It eliminates the difficult problem of exactly matching non-uniform waterstop cross sections to assure full water tightness.

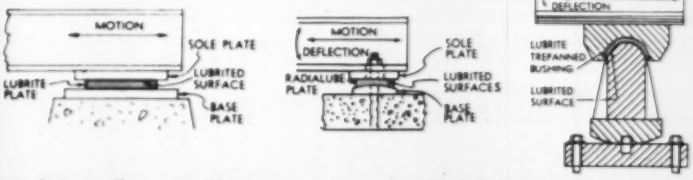
Nervastral Weldbar is a 4-sided "bar" with a somewhat lower melting point than Nervastral Waterstops. When heated on one side the end of a simultaneously heated waterstop can be pressed into the heated side of the bar. The dis-

(Continued on page 126)

SELF LUBRICATING SECURITY FOR CONNECTICUT TURNPIKE IS ASSURED WITH Lubrite® EXPANSION PLATES

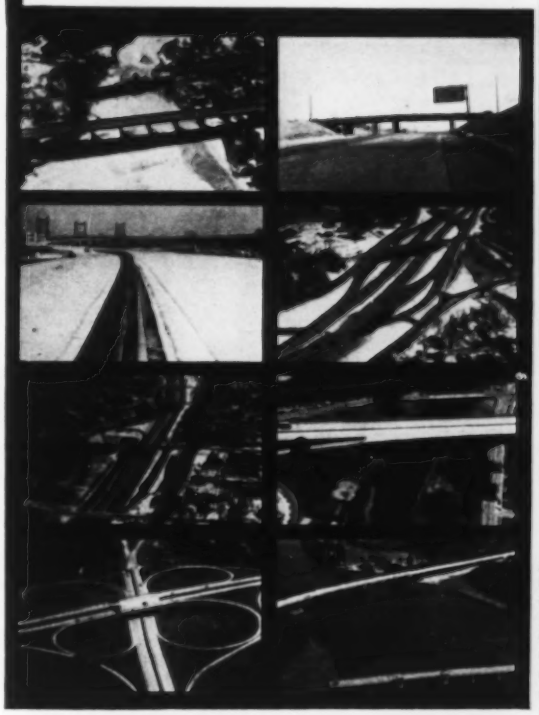


3 BASIC LUBRITE ASSEMBLIES FROM MANY AVAILABLE



Lubrite offers positive assurance of self lubricating security in all installations where expansion, contraction and/or rotation are factors.

SEND FOR THIS IMPORTANT AND VALUABLE LITERATURE—



Manual No. 55 contains complete information, technical data and specifications about Lubrite Expansion Plates and Bushings for bridges, buildings, refineries, atomic energy and chemical processing equipment applications.

Manual No. 56 covers Lubrite bushings, bearings and washers for use in machinery, industrial equipment, hydro-electric projects, missile and atomic energy applications and high temperature applications.

LUBRITE DIVISION
MERRIMAN BROS., INC.
193 Amory Street, Boston 30, Mass.

DISCERNING DRAFTSMEN THE WORLD OVER DEMAND IMPERIAL THE WORLD'S FINEST TRACING CLOTH

Annual Convention of ASCE
Oct. 10-14, 1960
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Date and hour of arrival .....

Date of departure .....

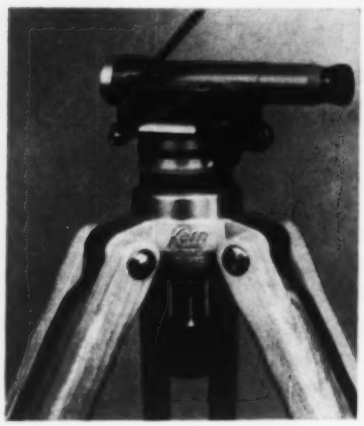
EQUIPMENT MATERIALS and METHODS

(continued)

placed material is forced out and up to form a bead along the joint which closely adheres to every rib and curve of the waterstop, thus effecting a perfectly watertight and lasting closure. **Rubber & Plastics Compound Co., Inc., CE-9, Time & Life Bldg., Rockefeller Center, New York 20, N. Y.**

Builder's Level

A SIMPLE BUILDER'S LEVEL specifically for American use, has been designed for builders, general contractors, surveyors and engineers. The GKO E is highly compact and portable, very rugged, and so simple in design as to require little adjustment. Despite its small size, the GKO E is more precise than what is commonly known as a "builder's level." It is designed for fast, simple operation,



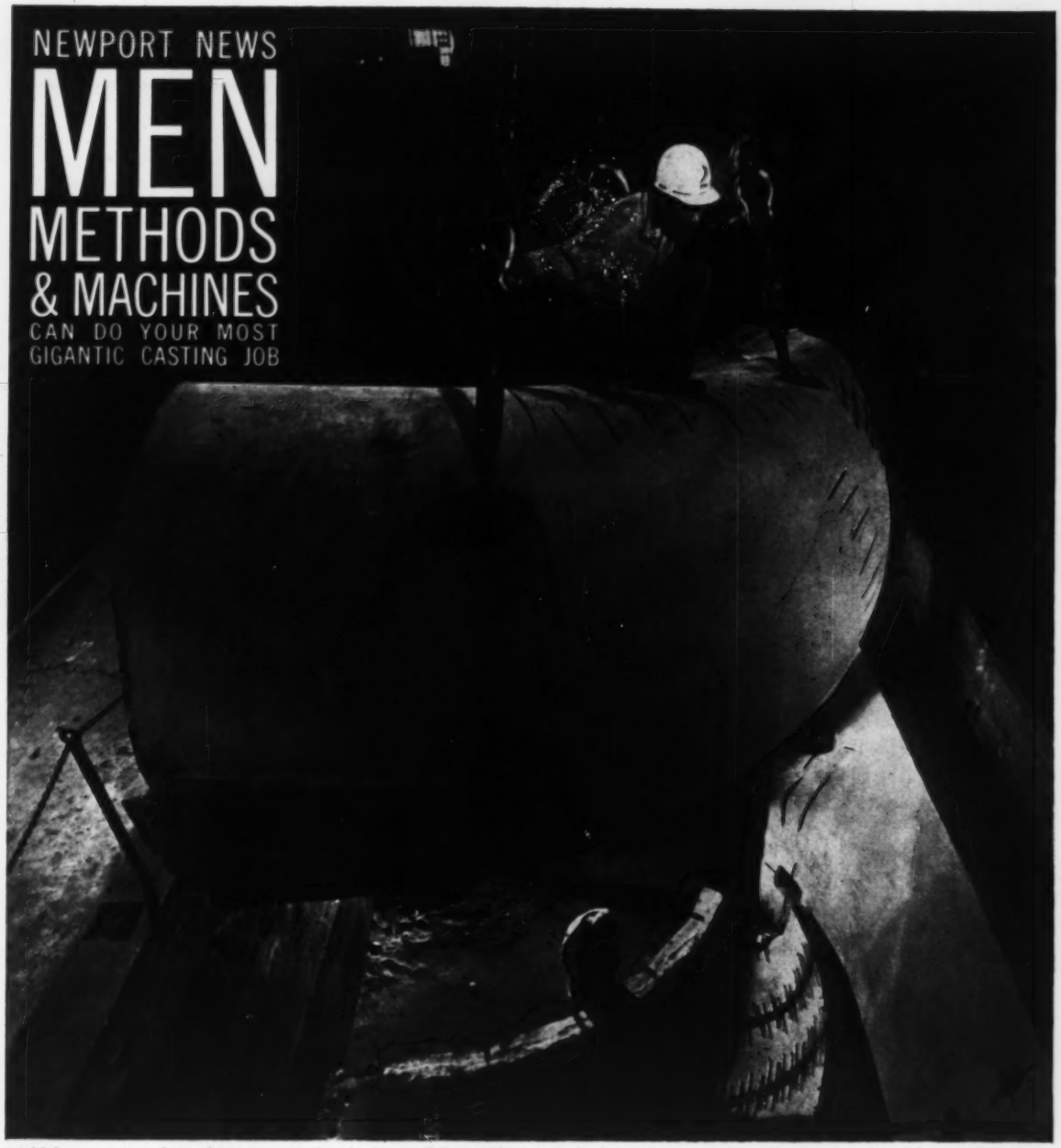
Kern-Swiss Builder's Level

an unskilled person can use it. All operations are from behind the instrument; the telescope level and bullseye level can be read simultaneously from the eyepiece end. The horizontal circle reading magnifier is placed underneath the bullseye level so that the operator can view both levels, read the circle and look through the telescope by a slight motion of his head, but without otherwise shifting his position. For finer adjustments a horizontal slow-motion screw has been added and the tilting screw has been moved to the eyepiece end of the telescope. The eyepiece adjustment is now threaded and equipped with a diopter scale and the focusing drive is of the rack-and-pinion type. **Kern Instruments, Inc., CE-9, 120-1 Grand Street, White Plains, N. Y.**

NEWPORT NEWS

MEN METHODS & MACHINES

CAN DO YOUR MOST GIGANTIC CASTING JOB



Mold for a section of a turbine stay ring for the Hartwell Power Plant. It is the largest one-piece Y-casting ever produced by Newport News.

It takes all three—men, methods and machines to tackle a job as big as this one! Newport News has completed many of them including six hydraulic turbines for the Niagara Project, four for the Hartwell Power Plant, and many others.

Newport News not only cast this giant unit but also milled it—and built the boring mill that did the work! No challenge is too great.

The secret of its leadership in the fabrication of heavy equipment is its staff of highly trained engineers and technicians, thousands of skilled workmen and 225 acre plant capable of turning out such projects as hydraulic turbines and valves, vacuum or pressure vessels for the petrochemical industry, bridge caissons, wind tunnels, and pulp and paper equipment.

Consult Newport News for preliminary recommendations at no obligation.

Newport News
SHIPBUILDING AND DRY DOCK CO.
NEWPORT NEWS, VIRGINIA

Authoritative books for engineers

NONDESTRUCTIVE TESTING HANDBOOK

This new pioneering Handbook covers all the means of testing the essential properties and performance capabilities of materials, parts, components, and structures *without impairing serviceability.*

Explains and illustrates applications, advantages, limitations of 24 different test methods applicable in every branch of engineering and industry. Specifications, equipment costs, hundreds of pages of test interpretation data. *Prepared under the auspices of the Society for Nondestructive Testing. 1,100 illustrations, graphs, tables; 1,910 pp. 106 Contributing, Consulting Editors. Robert C. McMaster, Ed. October, 1959.* 2 volumes, $24

PRODUCTION HANDBOOK

Packed with practical production know-how, this Handbook is the complete key to management-engineering methods that are revolutionizing industrial production today. Fully covers new materials, machines, processes, and proper functioning of company organization.

Supplies proved principles, time- and work-saving systems, and successful operating procedures for maximum productivity at minimum cost. Saves hours of research and costly experimentation. *726 illustrations, tables; 1,726 pp. 48 Contributing, Consulting Editors. Gordon B. Carson, Ed. 2nd Ed., 1958.* $16

MATERIALS HANDLING HANDBOOK

The complete guide to modern materials handling. This unique Handbook explains the governing principles, today's most efficient methods and systems, and recommended equipment for moving material at least cost — whether in raw, in-process, or finished form.

Useful in all industrial situations, Handbook answers every basic question of work flow within and outside the plant. *Sponsored by The American Society of Mechanical Engineers and the American Material Handling Society. 991 illustrations, tables; 1,740 pp. 84 Contributing, Consulting Editors. Harold A. Bolz, Ed.; George E. Hagemann, Assoc. Ed. 1958.* $20

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- ☐ Production Handbook, 2nd Ed., Carson 16
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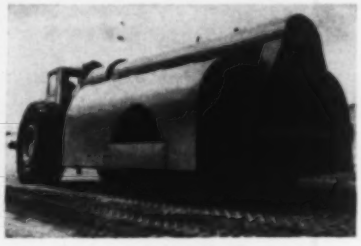
EQUIPMENT, MATERIALS and METHODS

(continued)

Ko-Cal Konsolidator

A TRACTOR-DRAWN PNEUMATIC tired roller puts 100,000 lb on the tires, plus 15,000 lb on the tractor. It is perfectly balanced for tractor traction and can roll down a course at speeds up to 10 mph. The Konsolidator weighs 37,000 lb empty, 115,000 lb fully loaded. The body has 700 cu ft of space for sand ballast and the towing frame has 130 cu ft of space for water ballast. The roller is about 29 ft long, 12 ft wide, and 10 ft high, and has 18.00 x 25—20 ply tires. **Koehring Company of California, CE-9, P.O. Box 1891, Stockton, Calif.**



50 Tons of Packing Power

Tension Testing Machine

THE MODEL TM-100 TENSION MACHINE designed especially for pulling reinforcing bars from No. 2 to No. 11 has been developed. Two ranges are available as standard equipment: zero to 30,000 lb and zero to 250,000 lb. Two sets of gripper blocks handle all sizes, including No. 2 and No. 11.

The manufacturer advises that the TM-100 can be arranged to test stranded cable in tension and 6 in. x 12 in. cylinders in compression, thus making it a multi-purpose apparatus. **Forney's Inc., Tester Div., CE-9, Box 310, New Castle, Pa.**

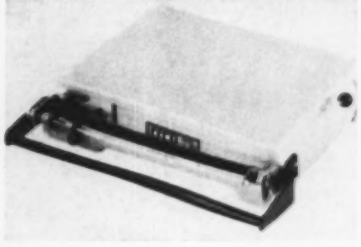
Tractor Shovel Equipment

A 107 HP GENERAL MOTORS diesel engine, a range of bucket sizes and three new attachments are now available as optional equipment for Michigan Model 85A Tractor Shovels, designed to increase the machine's production, versatility and ease of handling.

The Model 85A is available with a 96 hp Waukesha Model 195GK gasoline engine or a 91 hp Waukesha Model 197DLC diesel unit. The new diesel engine is General Motors' Model 5043. The Model 85A comes equipped with a 1¾ cu yd standard excavating bucket with a 9000 lb lifting capacity. In addition to the standard excavating bucket, optional buckets ranging in capacity from 1 to 2½ cu yd are now available for handling a variety of materials. The new attachments are a large-capacity rotary snow plow capable of handling up to 1200 tons of snow per hour, a compact street sweeper that can be mounted in place of the bucket, and a hydraulic snap-mount backhoe that can be attached to the rear of the machine in less than a minute without the use of tools. **Construction Machinery Division, Clark Equipment Co., CE-9, Pipestone Plant, Benton Harbor, Mich.**

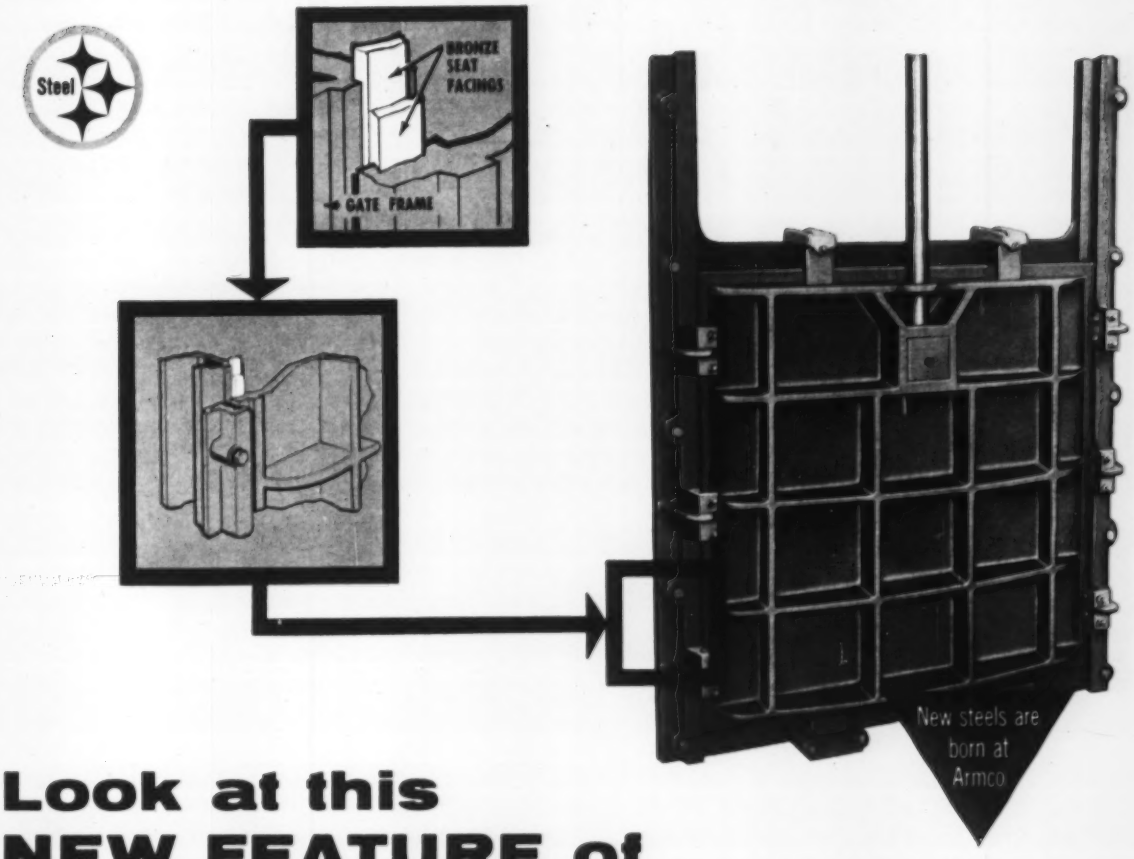
Portable Weighing Scale

THIS COMPANY ANNOUNCES the development of a new type of completely self-contained portable weighing scale for highway and general construction and all applications where scale portability is essential. This type of scale is suitable for field density, compaction and all other soils engineering determinations, as well as concrete aggregate weighings and bituminous test procedures.



Portable Scale

Features of this scale include: a full capacity beam permitting use of entire scale capacity without the addition of loose weights; a combination carrying handle and beam guard that permits carrying the scale as easily as a piece of luggage; special platform and beam locks that secure the lever system and beam, eliminating the necessity of rebalancing and readjusting the scale after it has been moved. The locking device also prevents wear and damage to pivots and bearings and eliminates rattles in transit. The scale beam is in front and below the weighing platform so that unobstructed use of the entire platform is permitted. The scales are available in capacities of from 51 to 300 lb graduated in fractions of ounces, ounces and in 1/10 of lb, and with metric scales in capacities of from 25 to 150 kg. All units can be supplied with blank or graduated tare beams. **Douglas Homs Co. CE-9, 326 Jackson St., San Francisco 11, Calif.**



Look at this NEW FEATURE of Armco Sluice Gates

Now you can get Armco Sluice Gates with bronze seating faces tightly anchored into dove-tailed grooves on both the slide and the frame. Both edges of the seating faces have the support of their beveled sides, with no overhanging surfaces. The actual bronze seating surfaces are machined perfectly flat for maximum watertightness.

This is just one advantage of Armco Sluice Gates. Others of special interest to engineers are: flush bottom opening; adjustable wedges; and a choice of metals for mounting materials. Then too, Armco offers you the world's widest selection of sluice gate sizes. See table for condensed data.

For more information on Armco Water Control Gates, write us, mentioning the type of gate that interests you. Armco Drainage & Metal Products, Inc., 6430 Curtis Street, Middletown, Ohio.

SIZE RANGE
and permissible unbalanced heads

Type of Gates	Sizes		Permissible Unbalanced Head	
	Round Openings	Square and Rectangular Openings	Seating in feet	Unseating in feet
Sluice Gates	6″ to 120″ diameters	6″ x 6″ to 108″ x 108″	5′ to 100′	0′ to 30′
Flap Gates	4″ to 90″	24″ x 24″ to 96″ x 96″	10′ to 50′	—
Roller Gates	—	9′ x 6′ to 30′ x 12′	0′ to 15′	0′
Radial Gates	—	8′ x 3′ to 20′ x 7′	0′ to 10′	0′

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10—52.5/6.6 H.P.—900/450 RPM

Complete with Texrope drives, motor starting cabinets, magnetos for fan speed indication and damper motors and controls.

FAN DATA

Quantity	Type	Volume Per Fan (cu. ft. per min.)	Static Pressure (in. of water)
6	Down Blast	120,400	2.12
4	" "	166,000	1.25
4	Up Blast	110,000	1.37
3	" "	125,000	2.00
3	" "	167,600	1.25

To be sold as a lot for removal by purchaser.

The system is to be discontinued in 1961. Approximately half of the equipment will be available about May, 1961, the balance about September, 1961. It is considered by owner to be in excellent condition; however, purchaser must rely on his own inspection.

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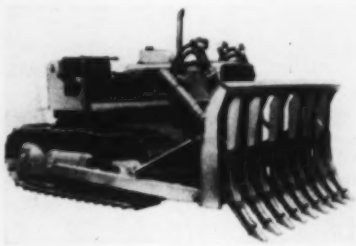
EQUIPMENT MATERIALS and METHODS

(continued)

Landclearing Rake Attachment

AVAILABLE FOR CABLE or hydraulic operations, bulldozing or angledozing, this new landclearing rake attachment moves trees, stumps, rocks and boulders but leaves the immediate dirt in position. It is available with or without top brushguard. If job application requires only rock and stump removal, the brushguard may be omitted.



Drott Landclearing Rake

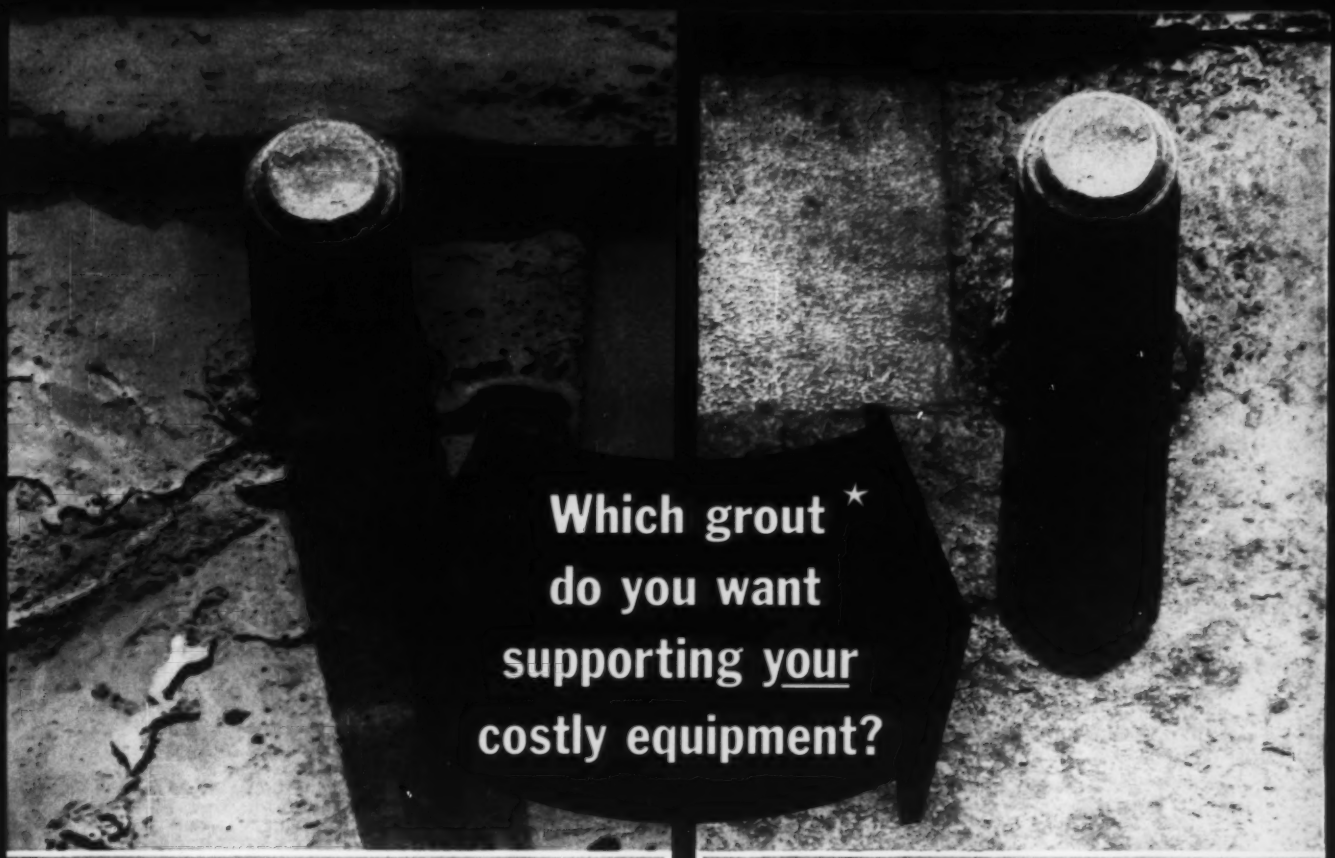
Teeth cast of special Manganese Molybdenum steel are individually mounted and can be adjusted to suit various specifications. On the bulldozer line, tooth pitch can be adjusted for uprooting stumps or raking action. Easily replaceable tips, secured by means of a sleeve and roll pin to prevent loss, add life to the rake. The rake comes in widths of 95 to 151 in., and weighs from 1,405 to 4,580 lb. The attachment is available for all International Harvester Tractors from the TD-9 through T-25. **Drott Manufacturing Corp., CE-9, Milwaukee 15, Wis.**

Consolidation Test Apparatus

CONSOLIDATION TESTS DETERMINE the probable time-settlement characteristics of soils under load. Using this test data, the settlements of a building, bridge abutment or similar structure may be predicted and the design based on these factors.

A new instrument, the British Autographic Consolidation Apparatus is reported to considerably reduce consolidation test time since readings are automatically recorded; the operator need not be continually present to record data. The apparatus has a maximum capacity of approximately 28 tons per sq ft on a standard 2½-in. dia test specimen. The recording mechanism is sensitive to 0.0001 in. of consolidation. The chart drum is rotated on a time base set for

(Continued on page 132)



PLAIN GROUT SHRINKS . . . leaves only a web of mortar and a small shim area to support the equipment baseplate. Result is a *short-life* grout that causes shutdowns . . . possible equipment damage . . . and expensive re-grouting.

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Today's figures show that *machinery* for the average U. S. factory costs $4,680,000[1] — a sizeable, important investment geared toward smooth, efficient production. But the *grout* under this valuable equipment *costs only pennies* by comparison.

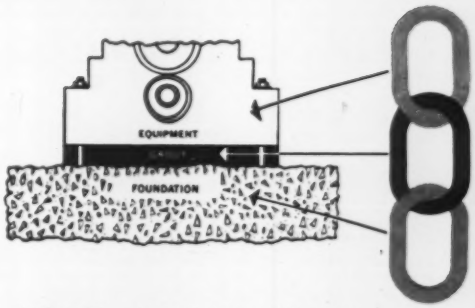
Compare the grouts pictured above. It's clear evidence that EMBECO can save *you* costly re-grouting and production downtime.

Here's why EMBECO means a superior grouting job every time—

- **Non-Shrink** . . . assures tight, level, permanent contact with equipment baseplate.
- **Flowable** . . . quickly, completely fills the space, increases ease of placeability.
- **Strong and Tough** . . . withstands impact, pounding action, vibration, side thrust and torque . . . maintains perfect alignment.

Before *you* grout another piece of heavy equipment—call in the local Master Builders field man for full information, or write to us for details on how EMBECO can help you *grout for good.*

[1]*U.S. average*—initial *machinery and equipment costs for new factories.*



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EQUIPMENT, MATERIALS and METHODS

(continued)

two different operating speeds: one speed records the primary settlement and the other the secondary consolidation. The dual type tester is supplied with weights, dial indicators as well as consolidometers. The machine is 34 in. wide by 42 in. deep and 32 in. high, and it weighs 450 lb. **Soiltest, Inc., CE-9, 4711 West North Ave., Chicago, Illinois.**

Hydraulic Hammer

THIS PORTABLE HAMMER speeds up backhoe or loader operations by cutting needless delays caused by hard-pan clay, rock formations, concrete or frozen ground. It increases profits by its versatility, power and dependability. The operating speed of the hammer makes it easy to handle. Its striking force is backed by hydraulic pressure. Attached to any hydraulic system having a capacity of at least 10 gpm, the hammer eliminates any need for other types of power source for such work. **Henry Manufacturing Co., Inc., CE-9, Topeka, Kansas.**

Powered for Profit

Concrete Forms

THESE WEATHER-RESISTANT forms, called Jay-Pans, are made of a heavy duty asphalt-impregnated material similar to asphalt roofing. They are tailored for any job, but if cutting is necessary they can be cut with a saw or pocket-knife. Tapered, adjustable, long-span, waffle or cored slab, Jay-Pans come in all standard sizes and any other sizes to fit your most economical module. **Lawrence Paper Co., CE-9, Lawrence, Kansas.**

Spraybar for Bituminous Distributors

THE NEW EK FULL-CIRCULATING spraybar features instant start and stop, no-drip shut-off, instant reverse suction and improved safety break-away. The sump castings have been redesigned: twenty seals and gaskets that were potential leak points have been eliminated, and enlarged passages within the sump now provide greater feed to the spraybar. Rear circulating piping has been removed, minimizing heat loss and flow restrictions. Each nozzle has its own valve mounted underneath the bar, but not extending up into the bar. Thus, the interior of the bar remains unobstructed and there is positive straight line discharge from all nozzles.

For changing application widths, individual valves can be disengaged by turning them away from the gang control. A damaged valve requiring replacement can be removed by unscrewing it from the bar. Nozzles and valves are on 4-in. centers, giving triple lap spray to assure uniform coverage. Minimizing the number of parts has resulted in a cleaner bar that is easier to maintain. **Rosco Manufacturing Co., CE-9, 3128 Snelling Ave., Minneapolis 6, Minn.**

Ductile Iron Pump Series

A COMPLETE SERIES OF single and multi-stage horizontal pumps cast in Ductile Iron has been placed on the market.

Described as pumps with extreme thermal shock and corrosion resistance, the two pump series, designated as the Peerless Type A and the Type TU and TUT, are for intermediate range service. Both the Type A and Type TU and TUT have a fluid temperature range of 350 deg. F.

The Peerless Type A pump is a continuous duty, horizontal split case, single stage centrifugal pump, which can be applied to the widest variety of pumping jobs handling water and other liquids, even when there is a modest amount of non-abrasive solids in suspension. It is available in sizes of 4 in. and larger; capacities to 60,000 gpm; heads to 400 ft. All types of drives are available for this pump.

The Peerless Type TU and TUT is a horizontal, split case, multi-stage pump, which is available in two stage (Type TU) and three, four or five stage (Type TUT) design. This series of pumps is ideal for supplying, circulating and boosting water and process liquids. Heads up to 1500 ft and capacities of up to 3000 gpm are readily handled by this pump group. **Peerless Pump, Hydrodynamics Div., Food Machinery and Chemical Corp., CE-9, 301 West Avenue 26, Los Angeles 31, Calif.**

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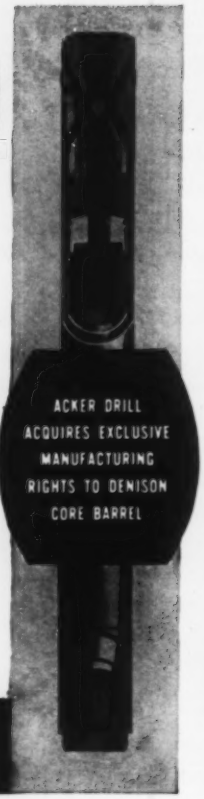

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EQUIPMENT MATERIALS and METHODS

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Engine Generators

THE ACCEPTANCE OF THE ORIGINAL 4B Series Winco Engine Generators with Maxi-Watt Power Control has indicated the need for another size with this revolutionary improvement in generator design. Series 31B143S2D-F will carry a 2500w load on a single 115 v or 230 v circuit, will power motors up to 1.5 hp or 2 hp or carry loads typical of many residential and commercial standby uses. In addition, the new 3I series have the Automatic Conserv-er, an idling control that saves up to 60% in fuel cost. These new engine generators are available in manual, electric or remote start with a choice of four convenient mountings. **Wincharger Corporation, Zenith Radio Corporation, CE-9, East 7th and Division Streets, Sioux City 2, Iowa.**

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Plastic Pipe

A NEW ISOPHTHALIC resin now being used in the manufacture of this company's glass fiber, thermosetting, corrosion service plastic pipe, has overcome many previous temperature and chemical limitations of plastic pipe. Plastic pipe made with the new resin will operate satisfactorily in continuous duty up to 350°F, and will handle acids, alkalines and many solvents easily, including hydrochloric acids and potash fluids up to 20 per cent concentrations.

Other benefits include: a greater fatigue resistance, greater durability, strength and improved chemical and physical properties. It is useful for corrosion service pipe line applications in many fields. It comes in 4-in., 6-in., 8-in., and 12-in. O.D. sizes. **Louis L. Potomac, Reflin Co., CE-9, Kearney Villa, San Diego 11, Calif.**

Literature Available

NEW ASCE DIRECTORY—The 1960 ASCE Directory listing the entire membership of the Society and giving the membership grade, position, and mailing address of each, is now available to ASCE members. To receive a free copy fill out the coupon on page 124.

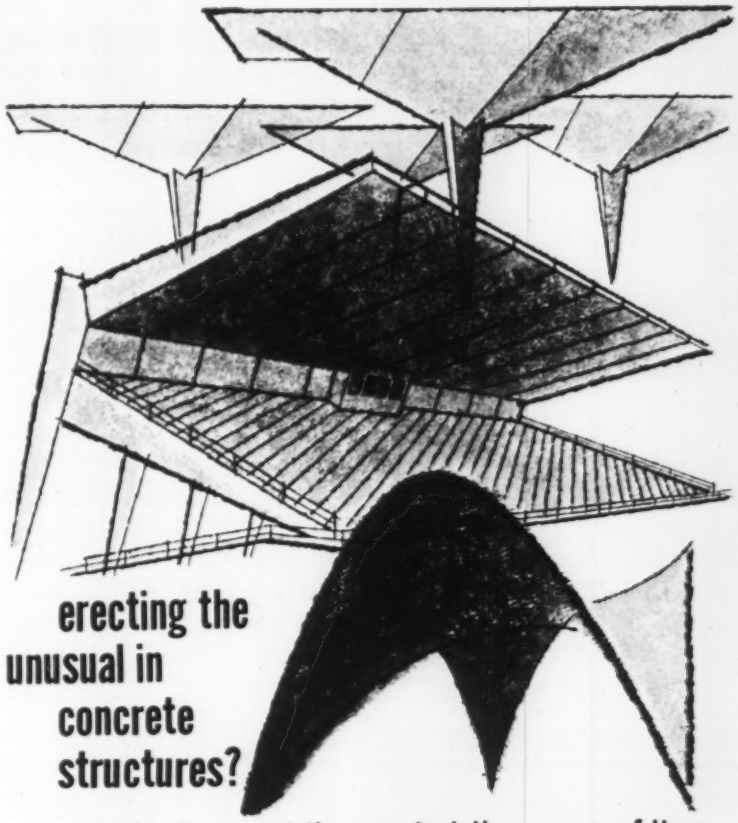
SALT FOR ROAD STABILIZATION—The use of salt for road stabilization, a growing practice on primary and secondary roads at local, county and state levels, is covered in detail in a new, illustrated, 24-page booklet. The booklet covers methods, applications, and advantages of salt stabilization. Design and materials, construction procedures, and maintenance and equipment needs are treated in detail. **Salt Institute, CE-9, 33 North LaSalle St., Chicago 2, Illinois.**

IN-PLACE DENSITY TESTER—The Volumeasure apparatus for in-place density tests, its applications and technical data are described in a new 2-page bulletin. The bulletin describes how the apparatus functions, the operational variations possible with it and its test capacities. Also there are complete construction details of the Volumeasure and an explanation of the assembly procedure. **Soiltest, Inc., CE-9, 4711 W. North Ave., Chicago 39, Illinois.**

SILICONE WATER REPELLENT—A catalog on Dehydratine No. 22 silicone water repellent for masonry surfaces, with its advantages, description, performance, method of application, packaging, and details of its six functions. **A. C. Horn Companies, Division of Sun Chemical Corporation, CE-9, 2133 85 Street, North Bergen, N. J.**

PRECAST CONCRETE SLABS—A newly released 6-page, 2-color folder shows how the Ohio Oil Co. used precast concrete floor and roof slabs to build their new 10-story office building in Findlay, Ohio. This folder's 19 photographs show how this type of construction permits a clean job, a quick close in, and allows other trades to move in quickly to work under cover. Also included is an explanation of how the hollow cells of the slabs were used as raceways for electrical power, telephone, signal and other low-voltage wiring. **The Flexicore Co., CE-9, 1932 E. Monument Ave., Dayton 1, Ohio.**

TRUCK AND FLOOR CRANES—Catalog W-102 gives complete specifications of all sizes and types of cranes from 500 to 4000 lb capacities for truck and shop floor use, enabling a maintenance manager to select the right crane for the right job—from one national source. A line of hand-operated winches is also shown, with capacities from 500 to 2000 lb. Hand winch specifications and limitation ranges are shown, so that decisions can be made for job applicability. **H. S. Watson Co., CE-9, 1316-67th St., Emeryville 8, Calif.**



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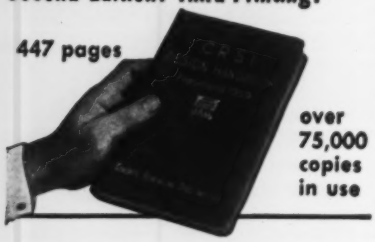

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Literature Available

LIGHTWEIGHT AGGREGATE CONCRETE—Bulletin MBR-P-14 features the wide use of lightweight aggregate concrete in modern construction. Photographs and job reports present a clear picture of the wide variety of uses for Pozzolith. Thirteen construction projects are featured with discussions covering the use of this relatively new and versatile building material for columns, beams and floor slabs, multi-story structures, thin shell concrete and bridge decks. **The Master Builders Co., CE-9, Cleveland 18, Ohio.**

PORTABLE CRUSHING AND SCREENING PLANT—A 1-page flyer D-146, describes and illustrates the new Diamond 70 portable crushing and screening plant. **Diamond Iron Works Division, Goodman Manufacturing Co., CE-9, Halsted Street and 48th Place, Chicago 9, Illinois.**

CURTAIN WALLS—A new 24-page manual contains ten curtain wall installation details developed jointly by a prominent architectural consultant and key members of this firm's Technical Department. The first five examples show custom-designed curtain walls, and the last five show standard commercial systems typical of those available on the market. The booklet is entitled "Vitrolux Spandrel Glass for Curtain Walls." **Advertising Department, Libbey-Owens-Ford Glass Co., CE-9, 811 Madison Ave., Toledo 1, Ohio.**

ROLLING SCAFFOLDS—"Superior Rolling Scaffolds" is a new 4-page folder describing the entire line of heavy duty, light duty and general purpose rolling scaffolds designed for construction workers, builders, painters, plasterers and maintenance trades. **Superior Scaffold Co., CE-9, 5624 Bankfield Ave., Culver City, Calif.**

VALVES—The bulletin, "Howell-Bunger Valves," 02B9206, announces the expansion of this firm's free discharge valve line with the introduction of a new economical low head valve for use under 200-ft head. The valve is available in sizes of from 12 in. to 108 in. by 6-in. increments, and is of lighter construction than the heavy duty valve designed for heads up to 400 ft. The valve is finding application in water works, hydraulic plants, and for irrigation and flood control. **Allis-Chalmers York Works, CE-9, York, Pa.**

PRODUCING QUALITY PHOSPHATE—An article describing the installation of flotation and reactor plants at San Francisco Chemical Co.'s property at Leefe, Wyoming, is offered in a 6-page bulletin (Technical Reprint No. 7059). The article describes the production of high quality phosphate from low grade carbonaceous ore through flotation and through calcining in FluoSolids® reactors. **Dorr-Oliver Inc., CE-9, Stamford, Conn.**

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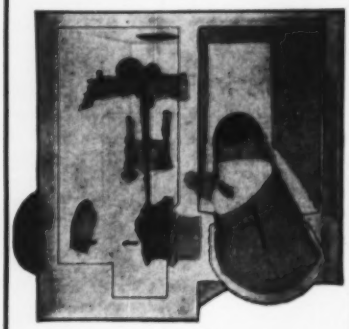

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

Descriptive Bulletins and Engineering Data Available Upon Request

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From the MANUFACTURERS

RELOCATION: Samborn, Steketee, Otis and Evans, engineers and architects, have moved from the Toledo Terminal Railroad building to the Libbey-Owens-Ford Building in downtown Toledo . . . **TWO NEW BUILDINGS:** The Rust Engineering Co., Pittsburgh, Pa., is handling the engineering and construction of two new buildings designed for warehousing and manufacturing, at the Cloquet operation of Wood Conversion Co., Saint Paul, Minnesota . . . **ADDED WAREHOUSES:** Stokvis Multiton Corp., manufacturer of non-powered industrial floor equipment, has tripled the size of its warehouse area with the completion of a new addition to existing facilities in Port Washington, N. Y. . . . **CONTRACTS AWARDED:** to Hope Construction Co., Chicago, for a new motor freight terminal, across the street from Midway Airport, by C. W. Terminals, Inc. . . . Prudential Insurance Co. has awarded a contract for a two story commercial building to Edward M. Waldron, Inc., in Newark, N. J. . . . Vitro Laboratories, a division of Vitro Corp. of America, has been given a $7-million contract for operation and maintenance of the Eglin Gulf Test Ranges in Florida, through June 1961 . . . **CONTROL CHANGE:** Control of Sentry Corp., Dover, Del., passed into the hands of Terry Industries, Inc., Long Island City, N. Y., a construction company . . . **NEW COMPANY:** Formation of A. T. Parker and Associates, Hollywood, Calif., makes available application of electronic principles and devices in the solution of problems in non-electronic businesses . . . **NAME CHANGE:** Midco Pipe & Tube, Inc., is the new name of Midcontinent Tube Service, Inc., Evanston, Ill. . . . **DISTRIBUTORS APPOINTED:** Quick-Way Truck Shovel Co. has appointed two new distributors: for Manitoba and part of Ontario, Frost Machinery Co., Ltd., of Winnipeg, and for the southeast Texas Territory, R. B. Everett and Co., Houston, Texas . . . CRS Industries, Inc., named Air Control Products, Lynn, Mass., as exclusive distributor of the Statronic System of Dirt and Dust Control in Massachusetts, Maine, Vermont, New Hampshire and Rhode Island . . . Miller Swivel Products, Inc., Pomona, Calif., has named the Osborne Equipment Co., Knoxville, as exclusive distributors for its products in central Tennessee . . . Albert & Harlow, Inc., of Tulsa and Ada, has been appointed distributor for Bucyrus-Erie crane-excavators in eastern Oklahoma . . . Naugatuck Chemical Division, U. S. Rubber Co. has appointed Poly-Chem Materials Corp., a subsidiary of Industro Transistor Corp., Long Island City, N. Y. as national distributor for Naugatile, an architectural coating for masonry and other surfaces . . . **APPOINTMENTS:** George O. Thompson has been named District Sales Representative, St. Louis territory, for the Pennsylvania Crusher Division, Bath Iron Works Corp., West Chester, Pa. . . . William C. McMichael has been appointed Director of Sales of CRS Industries, Inc., Philadelphia . . . Robert W. Forster has been appointed Marketing Services Manager for Chrysler Corporation's Airtemp Division . . . Shaltz Engineering Co., Flint, Mich., has been appointed new representative for Hydro-Line Manufacturing Co., Rockford, Ill. . . . Richard Donnelly Co., Suffield, Conn., has been appointed representative for Dynaray Emergency Lighting Equipment and Systems . . . Bill S. Kincaid has been promoted to Sales Manager of Goldak Co., Glendale, Calif. . . . Chain Belt Co., Milwaukee, has appointed G. H. Pfeifer as director of product merchandising and public relations, and Jack Heaps and Robert F. Olson as sales promotion managers of the construction machinery and industrial sections respectively . . . Joseph B. Willmering has been appointed Assistant Manager-Oil Country Tubular Products for U. S. Steel's National Tube Division . . . Irving P. Siminoff was named Western District Manager of the Electric Autolite Co.'s Electrical Products Division . . . Robert Bredeson, James H. O'Neil, Robert O. Robertson and John D. Tackett have been appointed Project Engineers in the engineering organization of the Manufacturing Department of Amoco Chemicals Corporation . . . Reuel M. Hanks is now Southeast States district representative for Quick-Way Truck Shovel Co.

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PROCEEDINGS AVAILABLE

August

Journals: Engineering Mechanics, Hydraulics, Power, Soil Mechanics and Foundations, Structural.

2564. Foundation Vibrations, by F. E. Richart, Jr. (SM) Theoretical solutions for the vibrations of foundations resting on soil have been studied and evaluated. For vertical vibrations, the theory for oscillators resting on an elastic semi-infinite body is usually required because of the effects introduced by the motion of the soil. Examples are given.

2565. Stresses in Layered Elastic Solids, by M. M. Lemcoe. (EM) General equations for stress are derived for multi-layer systems that satisfy conditions of plane strain. These equations may be used to calculate stresses in the supporting layered media for embankments, continuous footings, canals, etc., if the supporting media can be approximately represented as a two-layer plane strain system. The three and four layer cases may be solved with little additional difficulty with the aid of a digital computer.

2566. Reinforced Concrete Shear Wall Assemblies, by Jack R. Benjamin and Harry A. Williams. (ST) This paper gives the results of an investigation of one-story and two-story reinforced concrete shear wall assemblies. Eight models were tested. Theoretical and experimental results are compared.

2567. Lateral Stability of Frames by Energy Method, by Donald E. Johnson. (EM) A method of analyzing the elastic stability of rigid frame structures subject to sidesway is presented. Formulas describing the energies involved are given and presented in graph form. Two examples are given and compared to results obtained by more rigorous methods.

2568. Digital Computers for Trial-Load Analysis of Arch Dams, by L. R. Scrivner. (PO) Stress analysis of concrete dams is another engineering problem that can be expedited by the use of electronic computers. The use of the trial-load method has been restricted, because the programming of many of these operations for an electronic computer results in a saving of time and costs.

2569. Design of Arch Dams by Trial-Load Method of Analysis, by Merlin D. Copen. (PO) A brief resume of the basic principles involved in the trial-load method of stress analysis is presented. The various types of analyses, and their advantages and limitations, are examined. The application of trial-load methods to design problems and practical examples resulting from these procedures are illustrated and described in detail. It is also shown that the use of stress analysis is economical.

2570. Flood Distribution Problems Below Old River, by Frederic M. Chatry. (HY) Assuring the safe passage of flood flows on the Mississippi River at and below Old River requires that a controlled system of natural streams and artificial floodways be operated to distribute peak flows in accordance with the design capacities of the various system segments. The factors influencing the operation are examined.

2571. Seepage Losses from Parallel Canal Systems, by H. Y. Hammad. (EM) This paper deals with the two-dimensional problem of steady seepage flow under gravity from a system of parallel, identical, and equally spaced canals into a semi-pervious clay layer of finite thickness underlain by a freely permeable layer of sand and gravel in which the piezometric head is very near the canal water level.

2572. Vibrations of Structural Systems by Component Mode Synthesis, by Walter C. Hurty. (EM) Natural modes and frequencies of structural systems are determined by an energy method using mode functions, applicable to the complete system or subsystem, which are synthesized from admissible mode functions selected for the component members of the system. The synthesis is accomplished by using equations of constraint.

2573. Irrotational Motion of Two Fluid Strata Towards a Line Sink, by D. G. Huber. (EM) The flow of two fluids of different density toward a line sink located in the bottom corner of a rectangular configuration, with the upstream end extending to infinity, was studied by relaxation techniques. Relationships between the Froude numbers in the two layers were determined and the critical condition,

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when the lighter fluid begins or ceases to flow, was estimated.

2574. Pile-Driving Analysis by the Wave Equation, by E. A. L. Smith. (SM) There are a great many different pile-driving formulas in use, and engineers have never been able to agree as to which one is best. This paper gives engineers a mathematical method of wider application, depending on the use of electronic computers and numerical integration. The method is also applicable to other impact problems.

2575. Underground Structures Subject to Air Overpressure, by Ernest T. Selig, Keith E. McKee, and Eben Vey. (EM) An analytical procedure is presented for determining the damage to underground structures induced by pseudo-steady state air overpressure. By introducing appropriate assumptions from the fields of soil mechanics and structural dynamics, it is possible to derive analytical expressions that relate the parameters of the structure, the soil, and the loading as they affect the failure of the structure.

2576. Geometry of Moiré Fringes in Strain Analysis, by Stanley Morse, August J. Durelli, and Cesar A. Sciammarella. (EM) This paper shows how moiré fringes can be used in the two-dimensional analysis of strains. The fundamental equations of the moiré method are derived and are presented in the form of graphs by means of which strains and rotations can be obtained from simple measurements with a minimum of computation.

2577. Predicting Storm Runoff on Small Experimental Watersheds, by Neal E. Minshall. (HY) A method is presented for extending the period of runoff records based on analysis of existing short-term records of rainfall and runoff for a watershed, and a longer record of rainfall. A method for developing synthetic unit hydrographs for ungaged areas is also presented.

2578. Arch Dam Analysis with an Electric Analog Computer, by Richard H. MacNeal. (EM) An electric analogy that simulates the elastic deformations of arch dams is described. This analogy consists of resistors, transformers, and current generators. The results of an analog computer analysis of the Stevenson Creek Dam are compared with field measurements. The results of a design study of the Blue Ridge Dam are summarized.

2579. Design of Karadj Hydroelectric Project, by Richard D. Harza and Robert F. Edbrooke. (PO) This paper describes the development and design of a large water supply and hydroelectric project near Tehran, Iran. Also described are the high, double-curvature, thin-concrete arch dam; the extensive model-testing program; the reliable source of the municipal water supply; and the operation for peaking power with reregulating dam and pool.

2580. Elastic Model Design of the B-58 Airplane, by J. W. Wells and H. B. England. (EM) This paper outlines the extensive elastic model test program used in the design of a highly redundant structure on the B-58 airplane. Considerations in the design of the various models on the program are listed and several unique methods of obtaining and presenting test data are shown. Scale factors for both structure and loadings are developed in detail in the Appendix.

2581. Strength of Welded Aluminum Columns, by R. J. Brungraber and J. W. Clark. (ST) Welding heat-treated or cold-worked aluminum alloys causes partial annealing of the material in the vicinity of the welds, so that the strength of the material near the welds is lower than the strength of the material in the rest of the structure. An experimental and analytical investigation was conducted to determine the effect of the varying mechanical properties on column strength.

2582. Some Basic Concepts in Matrix Structural Analysis, by Frank R. Berman. (ST) The development of the electronic digital computer and the application of matrix algebra has made it possible for the structural engineer to analyze complex or highly redundant structures. Recently, papers have utilized the "flexibility" or "stiffness" matrix approach. This paper points out the common origin of these methods in energy and investigates procedures for calculating the total energy of a structure. The concept of the "total" structure will be considered. Applications include analysis of a truss with elastic supports and a continuous beam.

2583. Discussion of Proceedings Paper 2096, 2332, 2434, 2439. (EM) A. Hrennikoff on 2096. J. A. Veltrop on 2332. D. E. Hudson, G. W. Housner, and T. K. Caughey on 2434. George Pincus and George Winter on 2439.

2584. Discussion of Proceedings Paper 2130. (PO) Charles L. Townsend on 2130.

2585. Discussion of Proceedings Paper 2094, 2344, 2346, 2384, 2437, 2446, 2461. (ST) Nathan M. Newmark on 2094. Ming L. Pei on 2344. Valerian Leontovich on 2346. Henry J. Cowan and Oliver G. Julian on 2384. Clarence J. Derrick and G. W. Housner on 2437. Richard J. Newson on 2446. George B. Begg, Jr. on 2461.

2586. Discussion of Proceedings Paper 2216, 2294, 2295, 2319, 2368, 2431, 2453. (SM) R. E. Olson and J. D. Scott on 2216. Ernest Zube and Earl J. Felt on 2294. Frederick E. Crory on 2295. K. A. Linell on 2319. A. A. Eremin on 2368. D. F. Coates on 2431. Hashim H. Hamzawi on 2453.

2587. Discussion of Proceedings Paper 1997, 2058, 2084, 2339, 2340, 2362, 2369, 2374, 2469, 2478. (HY) S. V. Chitale, K. Arunachalam, F. Paderi, Joe M. Lara, and Kenneth B. Schroeder on 1997. Edwin W. Eden, Jr. on 2058. Ven Te Chow on 2084. G. C. Anderson, J. V. Radziul, and P. Celenza on 2339. Donald VanSickle on 2340. J. L. Kovner on 2362. Joseph N. Bradley on 2369. Herman G. Heinemann on 2374. Ven Te Chow on 2469. C. D. Smith on 2478.

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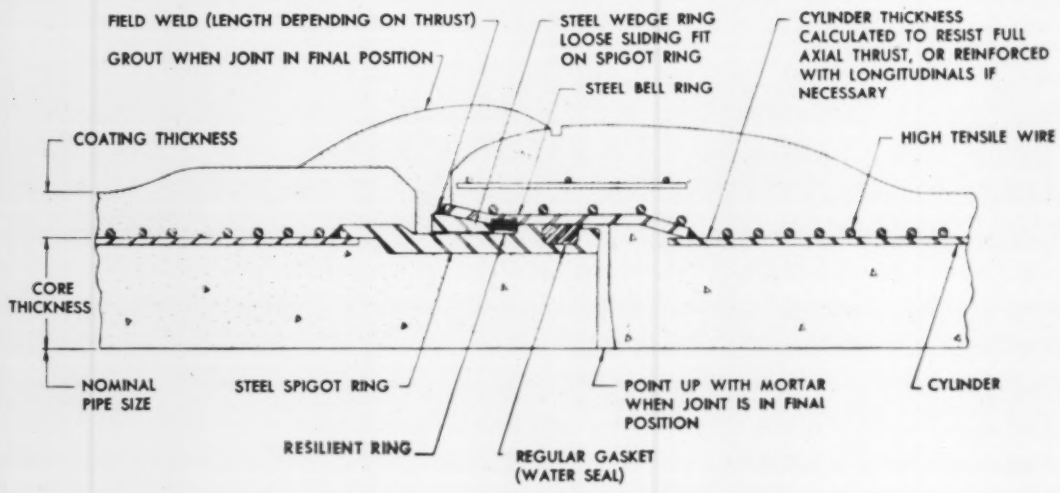
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